



National
Defence

Défense
nationale

UNCLASSIFIED

**UNLIMITED
DISTRIBUTION**

DRES

SUFFIELD MEMORANDUM

NO. 1227

**NATO REFERENCE MOBILITY MODEL
EVALUATION OF THE ILTIS 4 × 4 TRUCK (U)**

by

D.M. Hanna

and

D.M. Patterson

ACN 0316X

May 1988



DEFENCE RESEARCH ESTABLISHMENT SUFFIELD, RALSTON, ALBERTA

WARNING

"The use of this information is permitted subject to recognition of proprietary and patent rights".

Canada

UNCLASSIFIED

DEFENCE RESEARCH ESTABLISHMENT SUFFIELD
RALSTON, ALBERTA

SUFFIELD MEMORANDUM NO. 1227

NATO REFERENCE MOBILITY MODEL EVALUATION OF THE ILTIS 4X4 TRUCK (U)

by

D.M. Hanna
and
D.M. Patterson

ACN 0316X

WARNING
"The use of this information is permitted subject to
recognition of proprietary and patent rights".

UNCLASSIFIED

UNCLASSIFIED

DEFENCE RESEARCH ESTABLISHMENT SUFFIELD
RALSTON, ALBERTA

SUFFIELD MEMORANDUM NO. 1227

NATO REFERENCE MOBILITY MODEL EVALUATION OF THE ILTIS 4X4 TRUCK

by

D.M. Hanna

and

D.M. Patterson

ABSTRACT

1150
The Directorate of Land Requirements (DLR), in an effort to assess the usefulness of the NATO Reference Mobility Model (NRMM) in vehicle procurement activities, initiated a study at the Defence Research Establishment Suffield with the following objectives: 1) to determine the difficulty and time required to provide all necessary NRMM input data for a typical wheeled vehicle; 2) to determine the time required to perform an NRMM evaluation; and 3) to establish a wheeled vehicle baseline. The vehicle chosen for this study was the Iltis 4X4 ¼ ton truck. All required vehicle characteristics were obtained within an acceptable time frame with the exception of the pitch-mass-moment of inertia of the sprung mass, which eventually was measured at an American laboratory. The NRMM simulation of the Iltis 4X4 required approximately one month to complete. The baseline performance is represented by curves of speed versus cumulative percent of area and by a mobility rating speed of 40 kilometers per hour over representative German terrain.//

(ii)

UNCLASSIFIED

UNCLASSIFIED

ACKNOWLEDGEMENTS

The authors express their gratitude to the staff of the Land Engineering Test Establishment, particularly Maj. C. Guerette and Mr. G. Isnor, for their extensive contributions by way of measurement of vehicle characteristics and performance, and to members of the Directorate of Land Requirements, most notably Col. D.B. McGibbon and Maj. J. Sharpe, for entertaining the possibility of using mobility modelling in vehicle procurement activities and for subsequently initiating this task.

The authors also acknowledge the continual assistance rendered by the Computer Group of DRES in support of modelling activities.

(iii)

UNCLASSIFIED

UNCLASSIFIED

TABLE OF CONTENTS

Page

ABSTRACT	ii
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
1.0 INTRODUCTION	1
2.0 DESCRIPTION OF NRMM INPUT AND OUTPUT INFORMATION	2
2.1 Vehicle Information	2
2.2 Terrain Information	3
3.0 RESULTS AND DISCUSSION	4
3.1 Acquisition of Vehicular Data	4
3.2 NRMM Mobility Predictions	7
4.0 CONCLUSIONS	10
REFERENCES	12

TABLES
FIGURES

UNCLASSIFIED

TABLE OF CONTENTS cont'd

	<u>Page No.</u>
ANNEXES	
A. Vehicle Characteristics Requested from LETE	A-1
B. NRMM Input Data Package c/w Iltis Vehicle Characteristics	B-1
C. Summaries of Terrain Features of FRG and CFB Petawawa Off-Road Terrain Transects	C-1
D. Measurement of Weight Supported by Tires at Fording Depth	D-1
E. Measurements of Aerodynamic Drag Coefficient	E-1
F. Suspension and Power Train Characteristics Received from Bombardier	F-1
G. NRMM Terrain Unit Speed Predictions	G-1

UNCLASSIFIED

LIST OF TABLES

- Table 1 Percentage of total distance (area) travelled on each different surface type for specific mission profiles on FRG terrain.
- Table 2 Percentage of total distance (area) challenged within each surface type of FRG terrain.
- Table 3 Time penalties for off-road terrain.
- Table 4 Selected mobility speeds for the Iltis 4X4 assuming a tactical support mission profile on FRG roads and off-road terrain.

UNCLASSIFIED

LIST OF FIGURES

- Figure 1 Terrain Unit Map
- Figure 2 Plot of Speed vs. Cumulative Percent of Area for FRG
Off-Road Terrain
- Figure 3 Plot of Speed vs. Cumulative Percent of Area for
CFB Petawawa Off-Road Terrain
- Figure 4 Plot of Speed vs. Cumulative Percent of Distance for FRG
Roads and Trails

UNCLASSIFIED

DEFENCE RESEARCH ESTABLISHMENT SUFFIELD
RALSTON, ALBERTA

SUFFIELD MEMORANDUM NO. 1227

NATO REFERENCE MOBILITY MODEL EVALUATION OF THE ILTIS 4X4 TRUCK

by

D.M. Hanna

and

D.M. Patterson

1.0 INTRODUCTION

The NATO Reference Mobility Model (NRMM), a comprehensive computer program for predicting the mobility of land vehicles, is used regularly by the US Armed Forces to aid in vehicle procurement activities. It is utilized both to establish specifications of desired vehicle performance and to evaluate contending vehicles against these specifications.

The Directorate of Land Requirements (DLR) of the Canadian Forces, motivated by upcoming vehicle acquisition projects, is considering NRMM usage as well. This is the result of a desire by DLR staff to modernize and improve the specification of mobility requirements and the evaluation of mobility performance of contending vehicles. However, DLR became aware that, while NRMM mobility evaluations may be more desirable than those previously used, an NRMM simulation requires that prospective manufacturers provide extensive data regarding the

UNCLASSIFIED

specific characteristics of candidate vehicles. The following question resulted: "Are vehicle manufacturers prepared to devote the extra labour and expense required to provide this volume of vehicle data as an additional part of a proposal?"

Having had no prior requirements to determine the total complement of NRMM vehicle characteristics, it was deemed appropriate that DND gain experience with the determination of these data for an in-service vehicle, and hence establish the time and level of effort required to perform this chore. Also, it was obvious that a mobility evaluation of the same vehicle using the NRMM would provide an estimate of the time required for the analysis of a single vehicle and, at the same time, establish a wheeled vehicle baseline. For these reasons, DLR tasked the Vehicle Mobility Section of the Defence Research Establishment Suffield to perform an NRMM assessment of the Iltis 4X4 ¼ ton truck. This document reports on the experience of acquiring vehicle data and on the results of simulation runs.

2.0 NRMM INPUT DATA

This section briefly describes the vehicle and terrain information required by the NATO Reference Mobility Model for mobility performance predictions.

2.1 Vehicle Information

The NRMM requires input data regarding vehicle geometrical, inertial, and mechanical characteristics. Required geometrical data include items such as vehicle wheel base, approach and departure angles, and vehicle bottom profile. Sprung and unsprung masses and

pitch-mass-moment of inertia are some of the necessary inertial quantities. Suspension characteristics and power train description represent the majority of essential mechanical information.

The work involved in acquiring this large amount of data for the Iltis vehicle was divided as follows:

- 1) the Land Engineering Test Establishment (LETE) was tasked to measure or calculate the more intricate (or difficult to determine) vehicle characteristics; these are listed in Annex A;
- 2) Bombardier, the vehicle manufacturer, was requested to provide suspension and power train information; and
- 3) DRES was left to measure the more easily determined geometrical characteristics.

A package of data sheets was assembled which itemizes all of the vehicle characteristics required to perform NRMM simulation runs for wheeled vehicles (see Annex B).

2.2 Terrain Information

In addition to vehicle characteristics, the NRMM requires much terrain information before providing meaningful predictions of vehicle performance. For NRMM purposes, large areas of complex terrain (transsects) are simplified by dividing them into many small areas which are essentially uniform in terms of physical characteristics (see Figure 1). These finite areas of terrain are referred to as terrain units. Terrain units are described by 22 independent terrain charac-

teristics such as slope, soil type, seasonal soil strengths, ground roughness, and vegetation stem size and spacing. In like fashion, long stretches of road are divided into road segments which are described by nine independent characteristics, some of which are the same as for terrain units (i.e. ground roughness and slope). Examples of other road characteristics are curvature and surface condition. Also specified is the amount of off-road area or on-road distance associated with each homogeneous unit (see Annex C for a list of all terrain and road characteristics). With terrain described in this way, NRMM mobility predictions for large areas of terrain are achieved by providing speed predictions for numerous terrain units and road segments.

Upon initiation of this task, one set of data for on and off-road terrain from the Federal Republic of Germany was available for use. In the interim, new data became available for an area of Canadian terrain located within CFB Petawawa. Mobility predictions are provided for both areas. Annex C provides a summary of the distribution of terrain features for the FRG and CFB Petawawa off-road terrain areas.

3.0 RESULTS AND DISCUSSION

An assessment of the vehicle data acquisition experience and a discussion of NRMM modelling results are reported below.

3.1 Acquisition of Vehicular Data

As noted earlier, LETE was tasked to measure a number of items listed at Annex A. With the exception of pitch-mass-moment of inertia, LETE was able to respond to the task of measuring vehicle characteristics with existing equipment although, in several instances, unfamiliar

procedures were involved. The gross vehicle weight as well as the weight of each axle, when the vehicle is loaded to gross vehicle weight, were easily measured on the LETE weigh scale. The weight of the unsprung mass was determined by disassembling the axles and by summing the entire weight of totally unsprung components (i.e., tires, drums, etc.) and one half of the weight of partially sprung components (i.e., one end fixed to the sprung mass such as springs, shocks, axle, shafts, etc.). The weight of the sprung mass was then easily determined from the difference of the unsprung mass and the gross vehicle weight [2].

The weight supported by the tires at fording depth was determined by suspending the vehicle by a single cable and lowering it into the LETE swim tank to the rated fording depth. The load supported by each tire was subsequently calculated from the cable tension by applying ratios of tire weight to gross vehicle weight (measured while the vehicle is not fording) for each of the four wheel locations (see Annex D).

The centers of gravity for the vehicle at gross vehicle weight, at curb weight, and for the sprung mass were determined in each case by suspending the vehicle in three different fore/aft inclinations. The center of gravity location was then determined by sighting a vertical line from the suspension point down to the vehicle for each inclination. The resulting intersection of lines on the vehicle body located the center of gravity.

The aerodynamic drag coefficient was measured at the National Research Council wind tunnel facility for a range of wind speeds, and an average value was calculated (see Annex E). The hydrodynamic drag coefficient was determined by LETE using a method developed by ORAE.

The procedure involved rolling the vehicle down a known incline from a predetermined height into a measured depth of water. The hydrodynamic drag coefficient was calculated from the original potential energy and the total distance travelled in the water.

The pitch-mass-moment of inertia was measured by the University of Michigan Transport Research Institute (UMTRI) by the pendulum method, in which the vehicle is suspended by cables and made to oscillate like a simple pendulum. Originally, this measurement was to be made by LETE. However, errors which are often induced by the friction in the pivot joint of all but the most carefully constructed assemblies, compounded by errors in the length of the pivot arm which are further magnified in parallel axis theorem calculations, often result in grossly inaccurate results. A considerable amount of time was spent by LETE engineers investigating alternative means of measuring this quantity. However, after making several attempts to construct jigs to permit proper measurement, it was concluded that these methods were not possible within the time frame and cost constraints of this task.

Consequently, UMTRI was contracted to measure the pitch moment of inertia. The measurement was performed in less than a day after a vehicle was delivered to UMTRI. The vehicle's gross weight for this test was 3050 lb, and the measured moment of inertia was 13240 lb-in-sec². Hence the radius of gyration is 41.0 in or 1.04 m.

However, it should be noted that the value of the pitch-mass-moment of inertia actually measured by UMTRI was for the entire vehicle mass whereas the desired value, to be used in vehicle dynamic simulations, is for the sprung vehicle mass only. Therefore, it was necessary to adjust the value of the pitch-mass-moment of inertia to reflect the deletion of the unsprung mass. This was accomplished by assuming that the above value of radius of gyration was also valid for the

sprung mass.

Power train and suspension information were received within two calendar months of the date they were requested from the vehicle manufacturer, Bombardier (see Annex F). The information received was readily changed into NRMM compatible form.

Measurement of the required geometrical data took approximately two person-days of effort. The entire complement of required vehicle characteristics is assembled in Annex B in the NRMM Input Data Package.

3.2 NRMM Mobility Predictions

The NRMM quantifies mobility by providing predictions of speed-made-good for a vehicle in road or off-road operation. Speed-made-good between two points is defined as the straight line distance between the points divided by the total travel time, irrespective of the path chosen. A speed-made-good prediction for a terrain unit constitutes the basic output of NRMM. Speed predictions for all of the terrain units of the FRG and CFB Petawawa transects are listed in Annex G.

The baseline performance of the Iltis may be represented by graphs of speed versus cumulative percent of area. Figures 2 and 3 are graphs of speed versus cumulative percent of area for FRG and CFB Petawawa off-road terrain, respectively. These curves provide graphical summaries of the speed predictions for all terrain units of each transect. They give an easy means of obtaining an average predicted speed for any percentage of the total area of a transect. As the cumulative percentage of the total area of the transect increases,

it can be seen that the average achievable speed decreases. For example, in Figure 2 the Iltis is able to achieve a speed-made-good of approximately 22 kilometers per hour over 50 percent of the terrain. However, the speed-made-good value for 100 percent of this terrain decreases to approximately half that value. Such curves also provide a very clear indication of the no-go percent of area; in other words, the percentage of the area of the transect where the vehicle will have no mobility. For example, this value is approximately 75 percent of the total area of the Petawawa transect, Figure 3. Figure 4 is a similar graph for the three types of road surfaces found in the FRG transect.

In situations where the graphic representation is undesirable, the speed corresponding to a specific cumulative percent of area value is an alternative means of representing the baseline performance of a vehicle. The selected percent of area value is generally derived from the mobility level expected of a vehicle fulfilling a specified role. For example, established mobility levels used by the US Army are tactical high mobility, tactical standard mobility, and tactical support mobility. The mobility level dictates the percentage of off-road/on-road terrain on which the vehicle must be mobile (see Table 1). It follows that the speed corresponding to a specified percentage of off-road terrain (extracted from a graph such as Figure 2) is a single number which represents the baseline mobility of the vehicle on that terrain. The average speed corresponding to 80 percent of the cumulative area (V_{80}) of FRG off-road terrain is 20 kilometers per hour. This value represents a predicted average speed in the best (most easily trafficable) 80 percent of the terrain. Results of this form for on-road and off-road terrain (given a tactical standard mobility level as defined in Table 1) for the Iltis are summarized in Table 4.

In the case where, for a given area of terrain, both road and

off-road information are available, another single number called the mobility rating speed may be used to represent the vehicle baseline. The mobility rating speed (V_{MRS}) combines V_x values (where V_x is the average speed corresponding to $x\%$ of the cumulative area) from trails, primary and secondary roads, and off-road terrain into a more global measure of a vehicle's mobility. The mobility rating speed is calculated using

$$V_{MRS} = \frac{100}{\frac{\% \text{ off-road}}{V_x} + \frac{\% \text{ trails}}{V_x} + \frac{\% \text{ secondary roads}}{V_x} + \frac{\% \text{ primary}}{V_x} + TP}$$

where the V_x speeds are taken from applicable speed versus cumulative percent of area curves. The percent off-road, percent trails, etc., weighting factors are defined by the expected mission profile of the vehicle (see Table 2). For the Iltis in a tactical support role, for example, a typical mission profile specifies 5 percent of all distance is travelled off-road, 10 percent on trails, 55 percent on secondary roads, and 30 percent on primary roads.

While negotiating areas of off-road terrain, linear features such as streams, ditches, and roads are often encountered. In order to achieve a comprehensive mobility prediction, which is the aim of the mobility rating speed, some indication of the difficulty that a vehicle experiences when negotiating linear features must be included. The NRMM does not currently have, as a support module, an analytical model to predict retardation of vehicle progress when crossing such features. Therefore, this is accounted for empirically in the above equation by specifying a time penalty, TP.

Several factors influence the value of TP. The frequency of encountering linear features may be quite different from one geographical area to another. Also, the problems of ingress and egress depend, to a large extent, on the soil strength and soil moisture content of the banks or sides of the feature. Therefore, time penalties change for different weather scenarios (soil moisture content) and for different geographical areas as shown in Table 3.

For the example of an Iltis 4X4 in a tactical support role (V_x shown in Table 4) on FRG terrain and assuming a dry weather scenario, the mobility rating speed is calculated to be 40 kilometers per hour.

4.0 CONCLUSIONS

Conclusions regarding the process of obtaining vehicle characteristics are summarized as follows:

- 1) geometrical vehicle data were easily measured in a matter of days,
- 2) power train and suspension information was readily obtained from the vehicle manufacturer,
- 3) the majority of vehicle characteristics requested from LETE were measured with existing equipment using established techniques,
- 4) several unfamiliar (to LETE) characteristics were determined using existing equipment in new ways and by developing novel experimental procedures,

- 5) the pitch-mass-moment of inertia of the sprung mass was the most difficult characteristic to determine. LETE did not have and was not able to construct (within the time and financial constraints of this task) the facilities to accurately measure this value. A value for the pitch-mass-moment of inertia of the entire vehicle mass was obtained by contracting the University of Michigan Transport Research Institute. However, the corresponding value for the sprung vehicle mass is unavailable. An approximated value has been used in this report.

Concerning NRMM mobility predictions, the baseline mobility of a vehicle can be represented in several ways:

- 1) by graphs or tables of average speed versus cumulative percent of area, or
- 2) by mobility rating speeds (V_{MRS}).

The mobility rating speed is the most concise representation of overall performance. A set of graphs of speed versus cumulative percent of area for all surface categories (trails, off-road, etc) contains the most information regarding baseline performance. Both are useful ways of representing the baseline performance. Accordingly, the baseline performance of the Iltis 4X4 is represented by Figures 2 through 4 and by a mobility rating speed for FRG terrain (scenario = dry) of 40 kilometers per hour.

REFERENCES

1. Haley, P.W., Jurkat, M.P., Brady, P.M. Jr., "NATO Reference Mobility Model, Edition I, User's Guide. Volume I". Technical Report No. 12503. U.S. Army Tank Automotive Research and Development Command. October 1979.
2. Isnor, G., "Iltis Input Data for VEHDYN II". Personal communication. November 1987.
3. Haley, P.W., "Parameters for Mobility Rating Speed Equation". Personal communication. October 1985.

UNCLASSIFIED

MOBILITY LEVEL	PERCENTAGE OF TOTAL DISTANCE/AREA CHALLENGED			
	PRIMARY ROADS	SECONDARY ROADS	TRAILS	OFF-ROAD
Tactical High	100	100	100	90
Tactical Standard	100	100	90	80
Tactical Support	100	100	50	50

Table 1

Percentage of Total Distance/Area Challenged for Various
Mobility Levels Within Each Surface Type on FRG Terrain

UNCLASSIFIED

UNCLASSIFIED

MOBILITY LEVEL	MISSION PROFILE - PERCENTAGE OF TOTAL DISTANCE/AREA TRAVELLED IN EACH SURFACE TYPE			
	PRIMARY ROADS	SECONDARY ROADS	TRAILS	OFF-ROAD
Tactical High	10	30	10	50
Tactical Standard	20	50	15	15
Tactical Support	30	55	10	5

Table 2

Percentage of Total Distance/Area Travelled on Different Surface
Types for Specified Mobility Levels on FRG Terrain

UNCLASSIFIED

UNCLASSIFIED

SOIL CONDITION	TIME PENALTY	
	FRG	MID-EAST
DRY	.101	.025
WET	.109	.032

Table 3

Scenario Dependent Time Penalties for Off-Road Terrain

V_{100} Primary Roads (km/hr)	V_{100} Secondary Roads (km/hr)	V_{90} Trails (km/hr)	V_{80} Off-Road (km/hr)
68	52	15	20

Table 4

Selected Mobility Speeds (V_x) for the Iltis 4X4 Assuming a Tactical Support Mobility Level on FRG Roads and Off-Road Terrain

UNCLASSIFIED

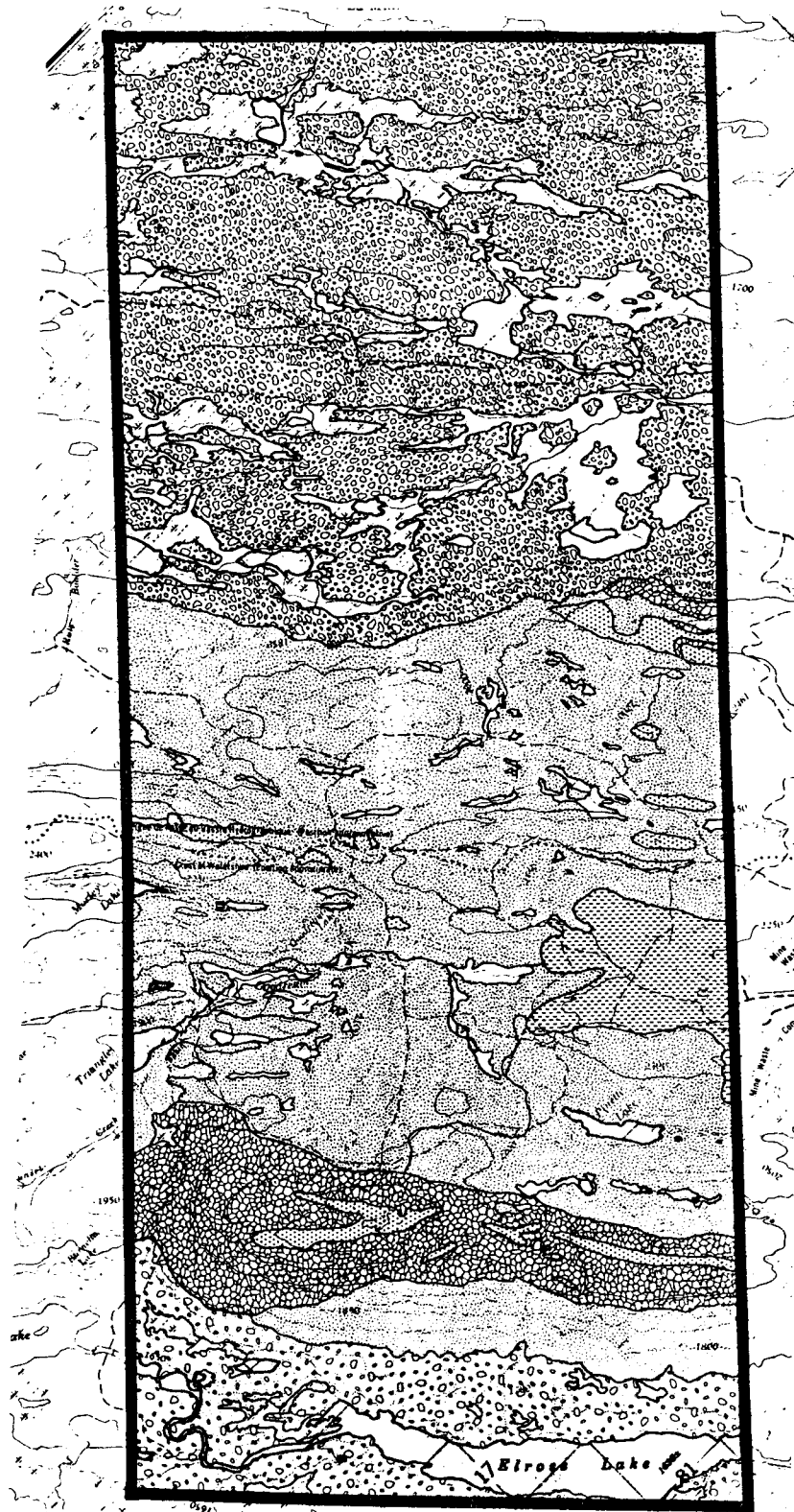


Figure 1. Partial map sheet with terrain unit map superimposed.

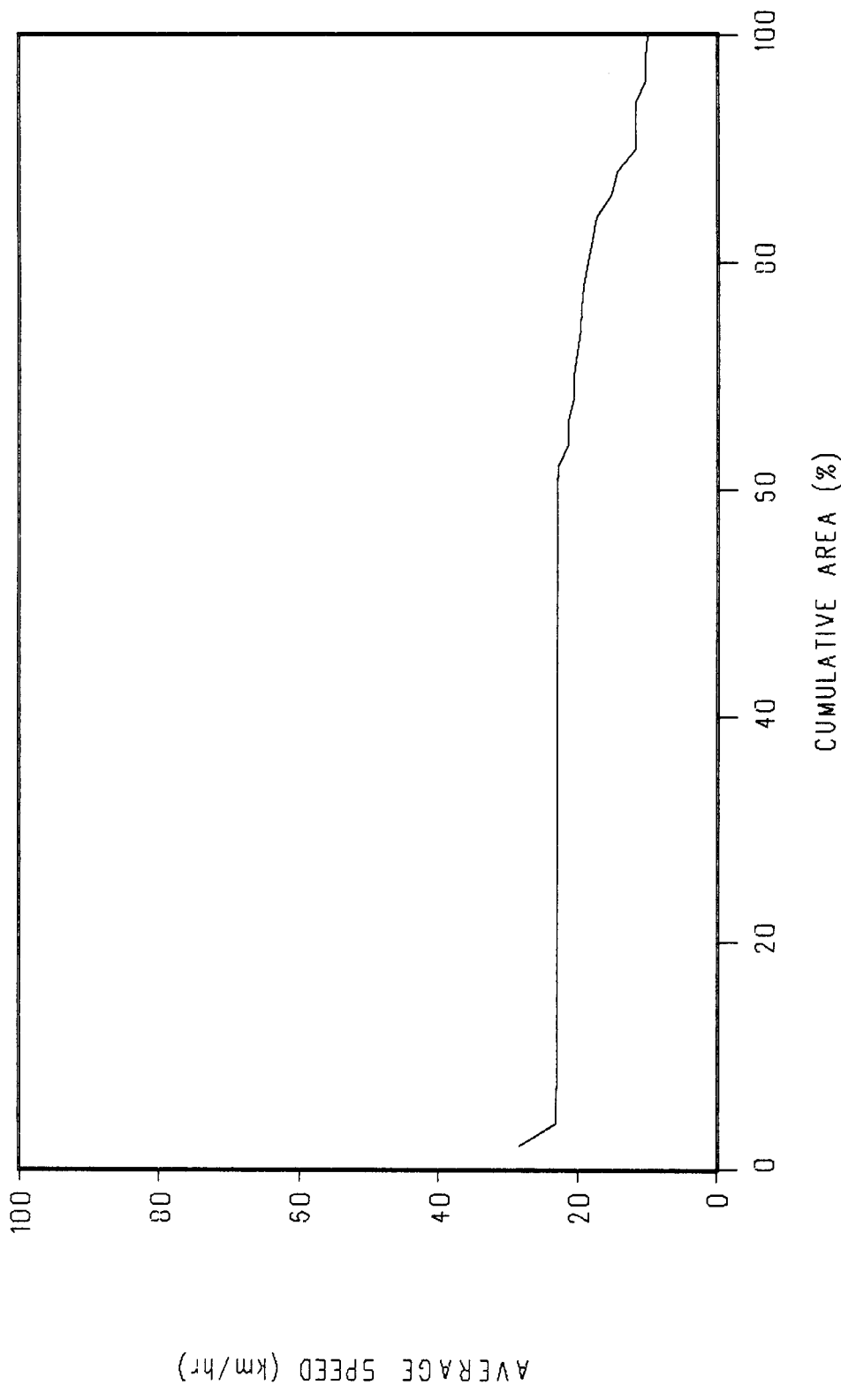


FIGURE 2. GRAPH OF CUMULATIVE AREA VERSUS AVERAGE SPEED FOR THE
 ILTIS 4X4 TRUCK ON FRG OFF-ROAD TERRAIN.

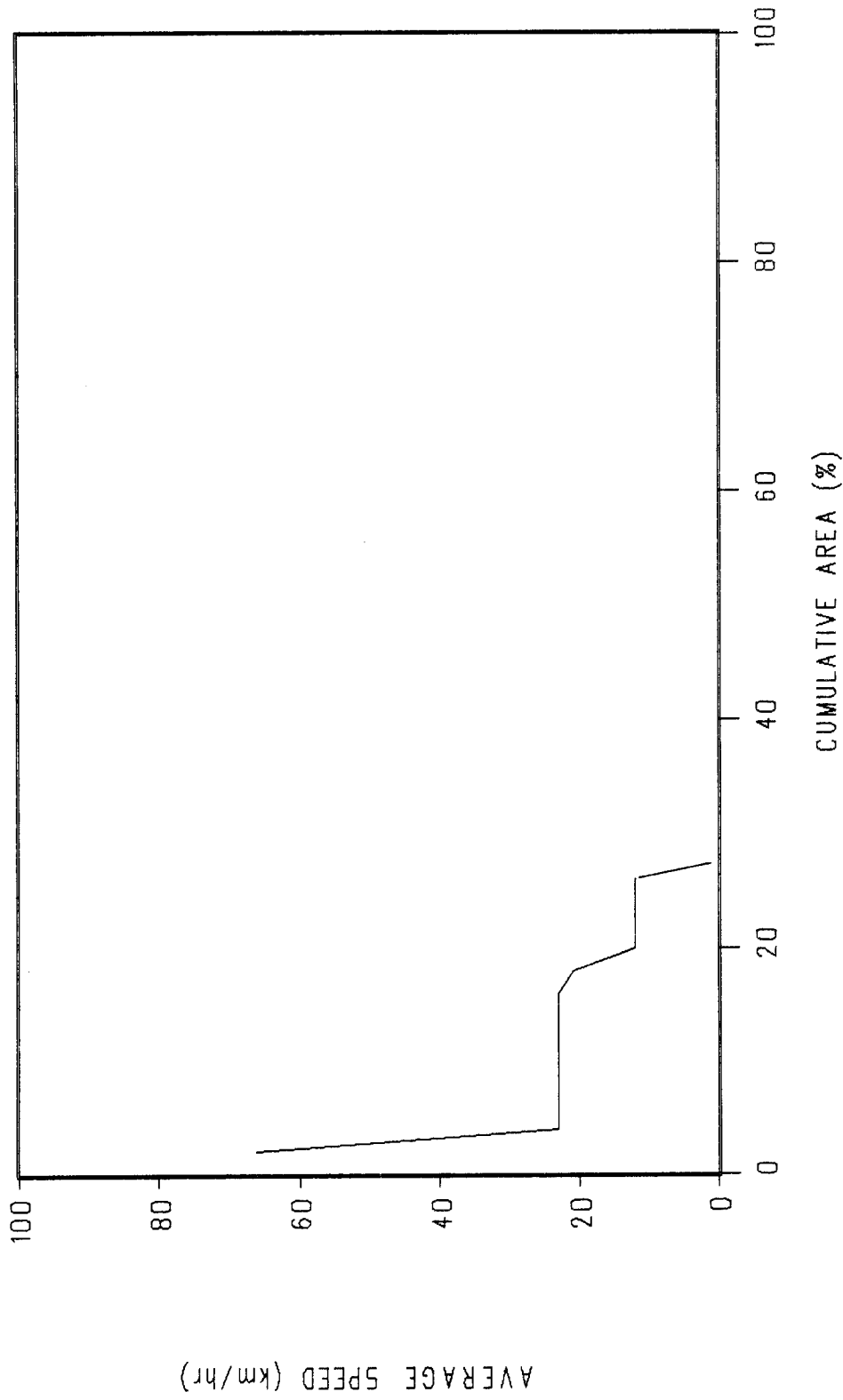


FIGURE 3. GRAPH OF CUMULATIVE AREA VERSUS AVERAGE SPEED FOR THE
 ILTIS 4X4 TRUCK ON CFB PETAWAWA OFF-ROAD TERRAIN.

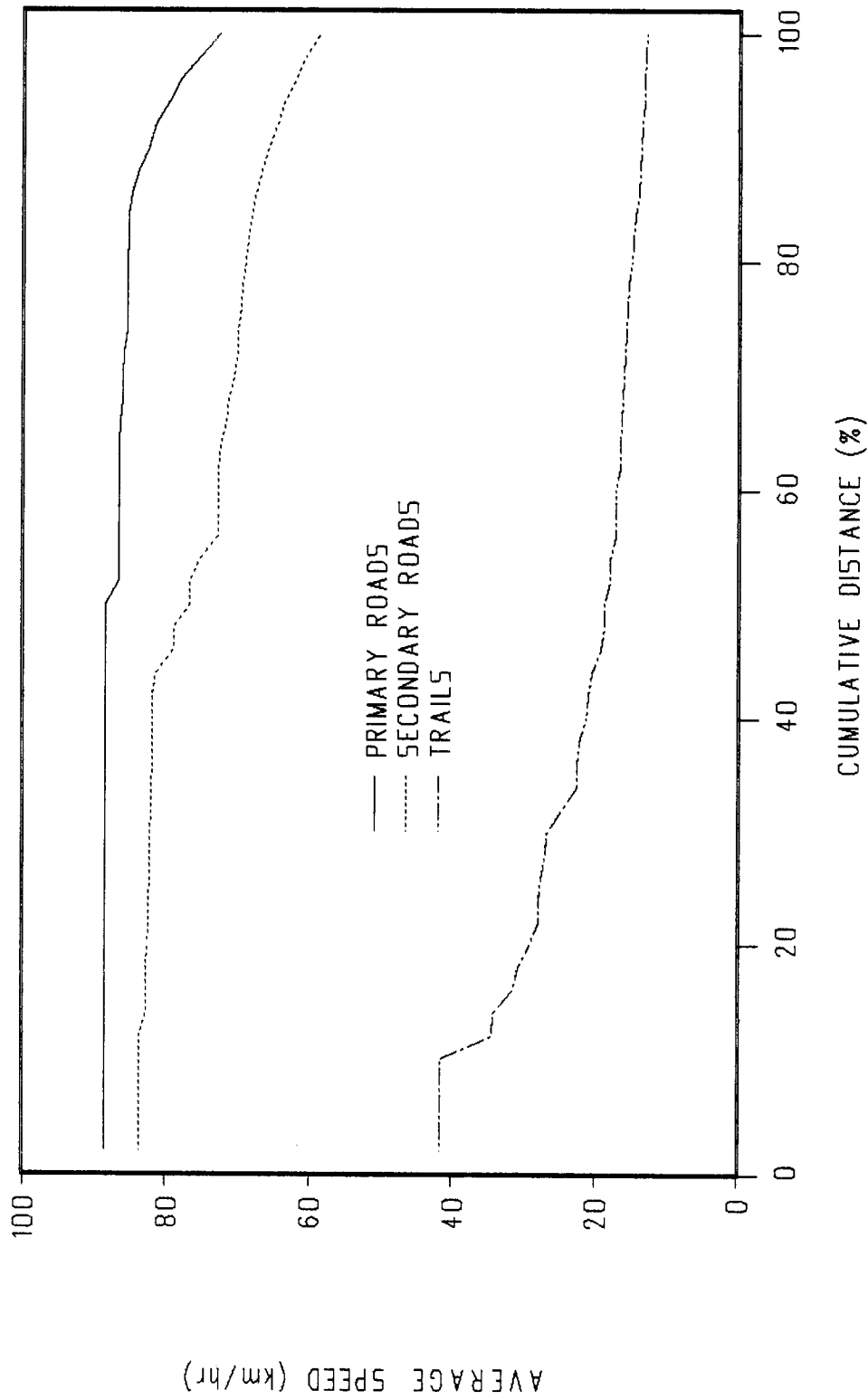


FIGURE 4. GRAPH OF CUMULATIVE DISTANCE VERSUS AVERAGE SPEED FOR THE ILTIS 4X4 TRUCK ON FRG ROADS AND TRAILS.

UNCLASSIFIED

ANNEX A

VEHICLE CHARACTERISTICS REQUESTED FROM LETE

UNCLASSIFIED

The following list itemizes all of the Iltis vehicle characteristics which LETE was tasked to provide:

1. Gross vehicle weight.
2. Weight of each axle of vehicle when laden at gross vehicle weight.
3. Weight of sprung mass.
4. Weight of unsprung mass for each axle.
5. Weight supported by tires at fording depth.
6. Center of gravity of vehicle at gross vehicle weight.
7. Center of gravity of vehicle at curb weight.
8. Center of gravity of sprung mass of vehicle.
9. Aerodynamic drag coefficient.
10. Hydrodynamic drag coefficient.
11. Pitch mass moment of inertia of sprung mass.
12. Maximum driver's seat acceleration as the vehicle negotiates obstacles of various sizes (optional).
13. Average absorbed power at driver's seat as the vehicle negotiates random terrain of various roughness values (optional).

UNCLASSIFIED

ANNEX B

NRMM INPUT DATA PACKAGE C/W ILTIS VEHICLE CHARACTERISTICS

UNCLASSIFIED

NRMM DATA SHEETS FOR WHEELED FIRST UNIT

PROJECT ILTIS

- 1.0 Identification
- 2.0 Geometrical Vehicle Characteristics
 - 2.1 Driver's Seat and CG Dimensions
- 3.0 Bottom Profile
- 4.0 Highway Characteristics and Mobility Assist System
- 5.0 Running Gear
 - 5.1 Running Gear - Tire Characteristics
- 6.0 Suspension Force Characteristics
 - 6.1 Suspension - Spring/Damper Tables
 - 6.2 Suspension - DMC Tables
- 7.0 General Suspension Characteristics and Unsprung Suspension
 - 7.1 Independent and Walking Beam Suspensions
 - 7.2 Walking Beam Suspension
 - 7.3 Bogie Suspension
 - 7.4 Bogie Suspension
- 8.0 Power Train - Description
 - 8.1 Power Train - Engine Characteristics
 - 8.2 Power Train - Transmission Characteristics
 - 8.3 Power Train - Final Drive and Transfer Gears Characteristics
 - 8.4 Power Train - Overall Gear Ratio Combinations
 - 8.5 Power Train - Tractive Effort vs Speed Relation
- 9.0 Speed Limited by Obstacle Impact
 - 9.1 Speed Limited by Roughness
- 10.0 Extras and Doubles

UNCLASSIFIED

B-3

PROJECT ILTIS

DATE 08/12/86

1.0

VEHICLE ID _____

INITIALS _____

1.0 - IDENTIFICATION

Vehicle Identification ILTIS 4X4-.5 ton jeep

1755	GVW
1170	VMMI
348	DELTW1
0	DRVWGT

Gross weight of entire vehicle (kg)

Pitch mass moment of inertia about the CG of vehicle sprung mass (kg - m²)

Payload weight (kg)

Combined weight of the driver and the driver's seat
(Driver = 80 kg, DRVWGT = 0 if no seat suspension exists)

Tires 6.50 R 16 cross country radial tires

Drive Train _____

Engine VW 049 : 4 cyl 4 stroke gasoline engine

Transmission Manual gear box with integrated differential, dry single plate clutch

UNCLASSIFIED

UNCLASSIFIED

B-4

PROJECT ILTIS

VEHICLE ID _____

DATE 08/12/86

INITIALS _____

2.0

2.0 - GEOMETRICAL VEHICLE CHARACTERISTICS

Vehicle/Unit length (mm)

Vehicle/Unit height (mm)

Vehicle/Unit width (mm)

Front pushbar height (mm)

Height of front hitch above ground (mm)

Height of rear hitch above ground (mm)

Front axle to end of vehicle (mm)

Front hitch to front axle (mm)

Front axle to rear hitch (mm)

Wheel base (mm)

Minimum chassis clearance (mm)

Approach angle (deg)

Departure angle (deg)

Horizontal coordinate of payload CG with respect to rear hitch (mm)

Vertical coordinate of payload CG with respect to ground (mm)

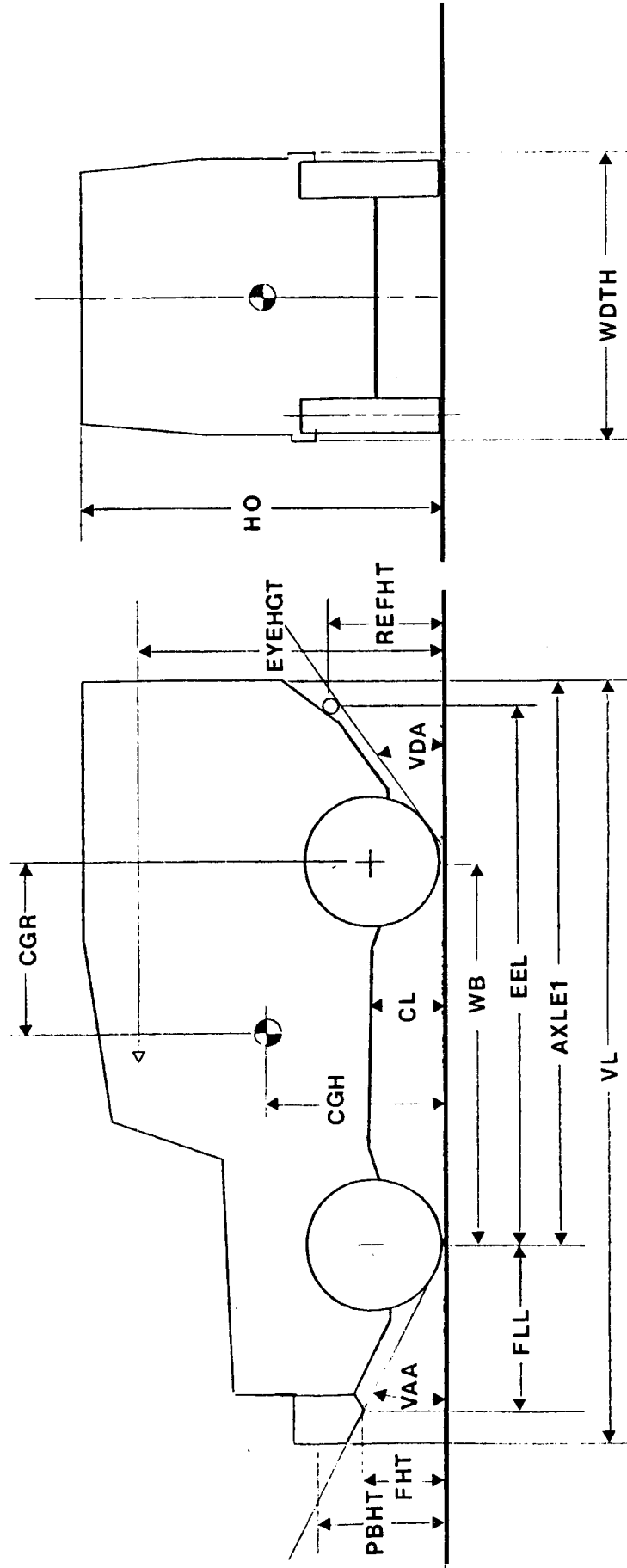
Minimum width between running gear elements (mm)

Distance from front of first running gear assembly to rear of last (mm)

FIRST UNIT

VL	3955
HO	1836
WDTH	1519
PBHT	800
FHT	541
REFHT	490
AXLE1	3066
FLL	760
EEL	2771
WB	2019
CL	330
VAA	41.5°
VDA	32.5°
DEEL	0
ZEE1	0
WI	1064
TL	2756

UNCLASSIFIED



PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86
INITIALS _____

2.1

2.1 - DRIVER'S SEAT AND CG DIMENSIONS

FIRST UNIT

Longitudinal distance from CG to base of driver's seat
 Vertical distance from CG to the base of driver's seat
 Vertical distance from the base of the driver's seat to driver's seat
 Number of the spring force deflection table to be used for driver's seat dynamics
 Number of the damper force velocity table to be used for driver's seat dynamics
 Driver's eye height
 Front axle to driver station

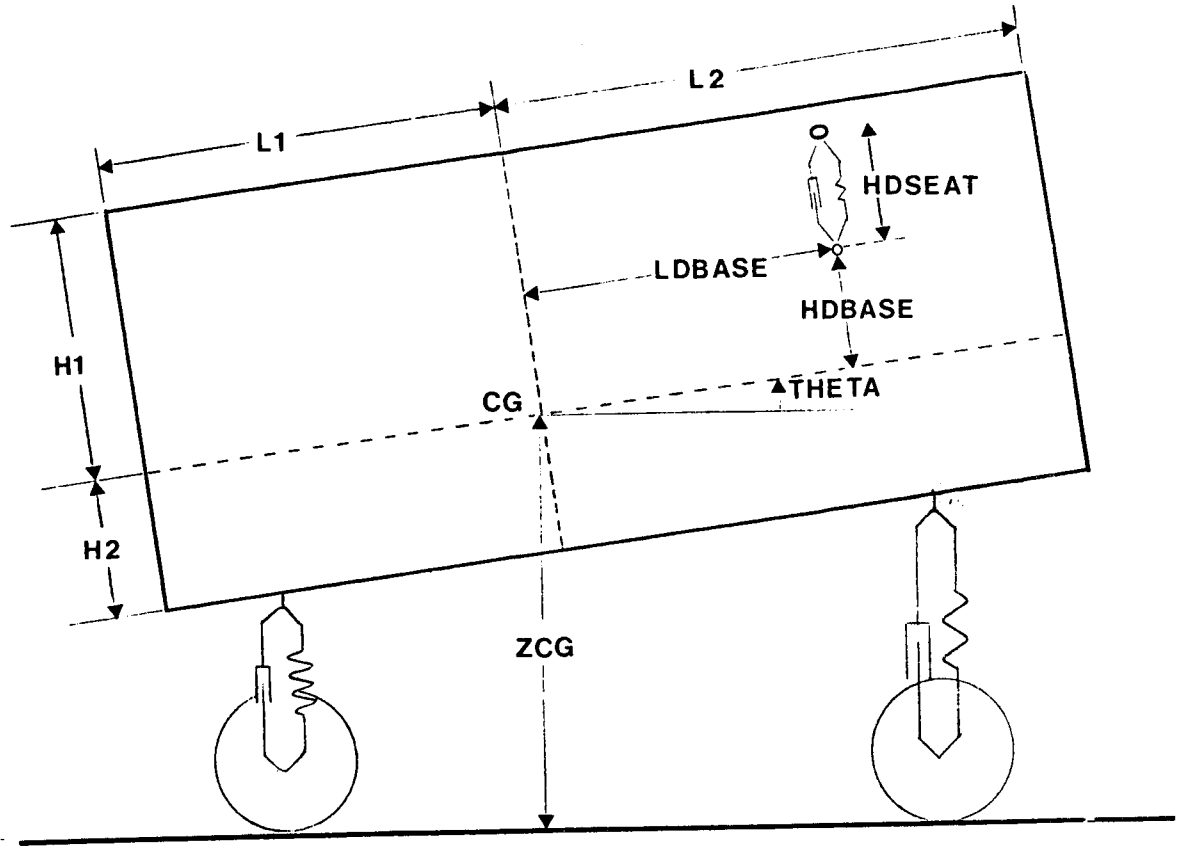
LDBASE	186
HDBASE	143
HDSEAT	0
ISDRV	0
IDDRV	0
EYEHGT	1334
	0

Rear axle to CG
 Height of CG above ground surface
 Vertical distance from bottom of vehicle's sprung mass to CG
 Vertical distance from CG to top of vehicle's sprung mass
 Longitudinal distance from rear end of vehicle's sprung mass to CG
 Longitudinal distance from the CG to the front end of vehicle's sprung mass
 Sprung mass' angle with respect to and measured counterclockwise from horizontal
 Lateral distance: center plane to CG

CGR	908
*CGH	673
H1	343
H2	1164
L1	1916
L2	2066
THETA	0
CGLAT	0

* CGH corresponds to CGZ1 and ZCG

VMS use only



PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86
INITIALS _____

3.0 - BOTTOM PROFILE

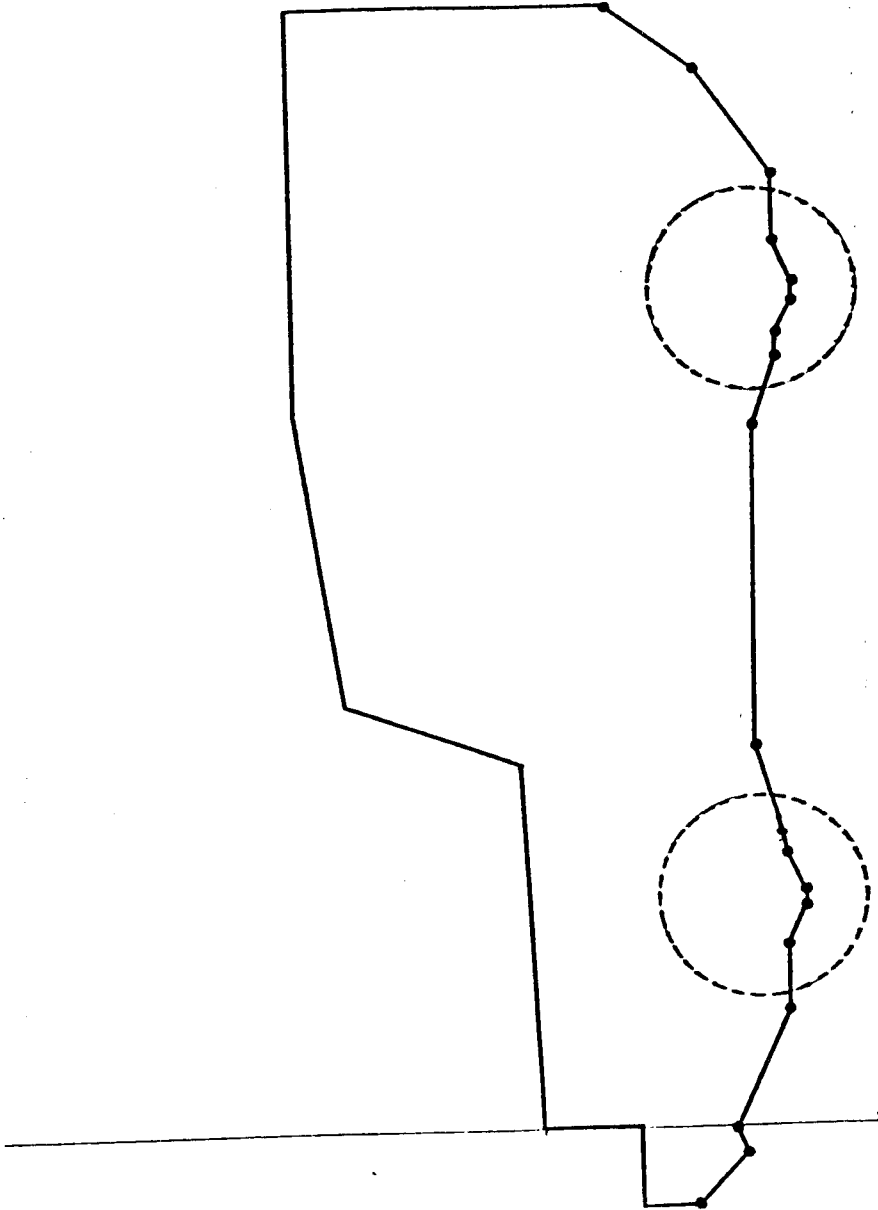
Number of x-y pairs in first unit bottom profile 19 NPTSC1

All heights are measured in mm from the ground with vehicle at operating load and cross-country conditions.

FIRST UNIT I = 1, NPTSC1

I	X XCLC1 (I)	Y YCLC1 (I)	I	X XCLC1 (I)	Y YCLC1 (I)
1	3725	800	13	783	205
2	3520	542	14	723	205
3	3160	270	15	600	270
4	2923	275	16	383	270
5	2801	205	17	0	452
6	2739	205	18	- 92	407
7	2617	255	19	-257	572
8	2550	265	20		
9	2320	350	21		
10	1263	360	22		
11	1023	285	23		
12	906	270	24		

UNCLASSIFIED



UNCLASSIFIED

UNCLASSIFIED

B-7

PROJECT
VEHICLE ID

DATE
INITIALS

08/12/86

4.0

4.0 - HIGHWAY CHARACTERISTICS

- Aerodynamic drag coefficient
- Projected frontal area (m²)
- Cornering stiffness of tires (N/deg)
- Hydrodynamic drag coefficient

0.537	ACD
2.53	PFA
534	AVGC
1.2	CD

- MOBILITY ASSIST SYSTEM

Pushbar/bumper capacity (N)

14200	PBF
-------	-----

Winch mounted? YES
NO

✓

If YES:

Identification/description

Capacity (N)

	WC
--	----

UNCLASSIFIED

UNCLASSIFIED

B-8

PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86
INITIALS _____

5.0

5.0 - RUNNING GEAR

NAMBLY	2
NSUSP	2
XBRCOF	0.7

Total number of axles

Total number of suspension assemblies

Maximum braking coefficient

	1	2	3	4
Axle number	1	2		
Suspension assembly number	1	2		
Operating load on axle (N)	7428	9786		
Steered (1) or unsteered (0) axle	1	0		
Powered (1) or unpowered (0) axle	1	1		
Braked (1) or unbraked (0) axle	1	1		
Number of tires on axle	2	2		
Singles (0) or duals (1)	0	0		
Chains ? Yes (1) or No (0)	0	0		
Wheel track (mm)	1230	1260		
Ground clearance under axles (mm)	250	9.8		
Lateral clearance between inner tires (mm)	1064	1095		
Undelected radius of the wheel (mm)	370	370		
Weight of the wheel assembly (N)	732	732		
Drive wheel (1) or towed wheel (0)	1	1		

*WGHT(I) corresponds to FUNDWL and EQUILF
 *R(I) corresponds to DIAW and EFFRAD
 *IP(I) and IB(I) correspond to IIP(I) and IIB(I)

VMS use only

UNCLASSIFIED

PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86
INITIALS _____

5.1 - TIRE CHARACTERISTICS

	1	2	3	4
Axle number	0	0		
Bias (1) or Radial (0) tires	ICONST(I)			
Tire ply rating or load range	TPLY(I)	10		
Undelected tire section width (mm)	SECTW(I)	165		
Undelected tire section height (mm)	SECTH(I)	140		
Tire nominal revolutions/km	REVM(I)	450		
Central inflation system (yes/no)				
Tire highway inflation pressure (Kpa)	*TPSI(I,3)	500		
Deflection under load and highway inflation (mm)	*DFLCT(I,3)	10	13.5	
Max allowable speed at highway inflation (km/h)				
Tire sand inflation pressure (Kpa)	TPSI(I,2)	315		
Deflection under load and sand inflation (mm)	DFLCT(I,2)	13.5	18	
Max allowable speed at sand inflation (km/h)				
Tire cross-country inflation pressure (Kpa)	TPSI(I,1)	390		
Deflection under load and cross-country inflation pressure (mm)	DFLCT(I,1)	12	16	
Max allowable speed at cross-country inflation pressure (km/h)				
Rim diameter	RDIAM(I)	406		
Rim width	RIMW(I)	114		
Rim flange height				
Force at tire deflection for ride analysis				

*TPSI(I,J) and DFLCT(I,J) correspond to ZFORCE(I) and DEFL(I) respectively for VEHDYN. VMS use only

UNCLASSIFIED

B-10

PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86

6.0

INITIALS _____

6.0 - SUSPENSION FORCE CHARACTERISTICS

Number of unique Spring Force - Deflection Tables

Number of unique Damper Force - Velocity Tables

1	NSTABL
1	NDTABL

TABLE NUMBER J = 1, NSTABL or J = 1, NDTABL

J = 1 or J = 1

Spring Force
Deflection Table

9	NSLOAD(J)
0	NSUNLD(J)
0	ATSPOS(J)
0	BTSPOS(J)
0	ATSNEG(J)
0	BTSNEG(J)
0	STKNEG(J)
172	STKPOS(J)

Damper Force
Velocity Table

11	NDLOAD(J)
0	NDUNLD(J)
0	ATDPOS(J)
0	BTDPOS(J)
0	ATDNEG(J)
0	BTDNEG(J)

Number of data points in loading portion of the Jth table

Number of data points in unloading portion of the Jth table

Coefficient A1/A3 used for the Jth table

Exponential coefficient B1/B3 used for the Jth table

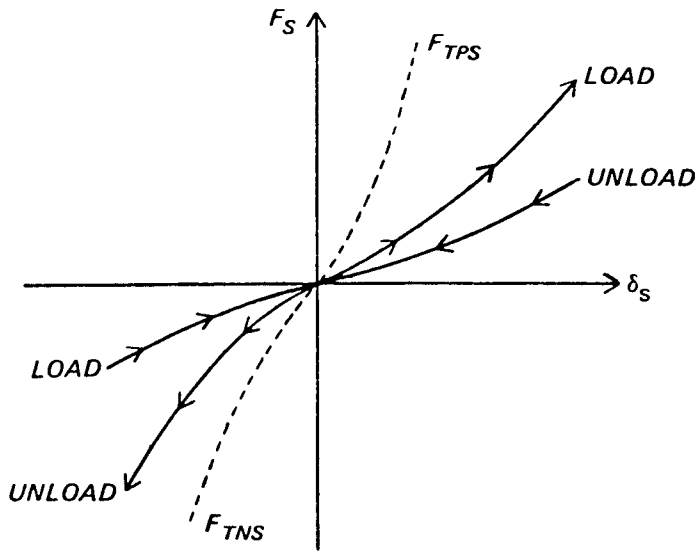
Coefficient A2/A4 used for Jth table

Exponential coefficient B2/B4 used for Jth table

Displacement of rebound bump stop from Jth table (mm)

Displacement of jounce bump stop from Jth table (mm)

UNCLASSIFIED

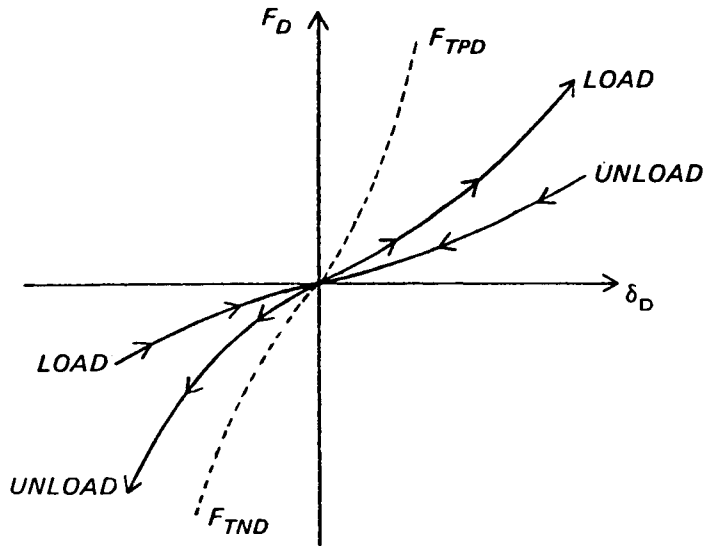


TRANSITION CURVES

$$F_{TPS} = A1 (e^{B1 \cdot \delta_S} - 1), \delta_S > 0$$

$$F_{TNS} = A2(1 - e^{-B2 \cdot \delta_S}), \delta_S < 0$$

NON-LINEAR HYSTERETIC SPRING-FORCE DEFLECTION MODEL



TRANSITION CURVES

$$F_{TPD} = A3(e^{B3 \cdot \dot{\delta}_D} - 1), \dot{\delta}_D > 0$$

$$F_{TND} = A4(1 - e^{-B4 \cdot \dot{\delta}_D}), \dot{\delta}_D < 0$$

NON-LINEAR HYSTERETIC DAMPER-FORCE VELOCITY MODEL

DATE 08/12/86
INITIALS 6.1

PROJECT ILTIS
VEHICLE ID _____

6.1 - SUSPENSION SPRING/DAMPER TABLES

SPRING FORCE - DEFLECTION

DAMPER FORCE - VELOCITY

J = 1

I = 1, NSLOAD

I = 1, NSUNLD

I = 1, NDLOAD

I = 1, NDUNLD

N S L O A D	DEFL. (mm) DELSLD (I,J)	FORCE LOAD (N) FORSLD (I,J)
1	-25	-66700
2	0	0
3	25	1356
4	50	2712
5	75	4067
6	100	5423
7	125	6779
8	150	8135
9	175	74858
10		
11		
12		
13		
14		
15		
16		

N S U N L D	DEFL. (mm) DELSUN (I,J)	FORCE UNLOAD (N) FORSUN (I,J)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

N D L O A D	VEL. (m/s) DDOTLD (I,J)	FORCE LOAD (N) FORLDL (I,J)
1	-2.5	-1690
2	-.34	-1690
3	-.22	-1550
4	-.11	-1326
5	-.04	-517
6	0	0
7	.04	219
8	.11	517
9	.22	687
10	.34	802
11	2.5	802
12		
13		
14		
15		
16		

N D U N L D	VEL. (m/s) DDOTUN (I,J)	FORCE UNLOAD (N) FORDUN (I,J)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

PROJECT ILTIS
 VEHICLE ID _____

DATE 08/12/86
 INITIALS _____

6.2 - SUSPENSION DMC TABLES

Number of unique DMC - deflection tables for positive velocities

Number of unique DMC - deflection tables for negative velocities

Number of data points for positive velocities in Jth DMC table

Number of data points for negative velocities in Jth DMC table

0	NDMTBP
0	NDMTBN
	NDMODP(J)
	NDMODN(J)

DMC - DEFLECTION/POSITIVE VELOCITY J = _____

DMC - DEFLECTION/NEGATIVE VELOCITY J = _____

I = 1, NDMODP

I = 1, NDMODN

N D M O D P	DEFL. (mm) DELMDP (I,J)	DMC CFMODP (I,J)	N D M O D P	DEFL. (mm) DELMDP (I,J)	DMC CFMODP (I,J)
1			9		
2			10		
3			11		
4			12		
5			13		
6			14		
7			15		
8			16		

N D M O D N	DEFL. (mm) DELMDN (I,J)	DMC CFMODN (I,J)	N D M O D N	DEFL. (mm) DELMDN (I,J)	DMC CFMODN (I,J)
1			9		
2			10		
3			11		
4			12		
5			13		
6			14		
7			15		
8			16		

UNCLASSIFIED

DATE 08/12/86
INITIALS

PROJECT ILTIS
VEHICLE ID _____

7.0 - GENERAL SUSPENSION CHARACTERISTICS AND UNSPRUNG SUSPENSION

NU	0
NI	2
NW	0
NB	0

Number of Unsprung suspensions

Number of Independent suspensions

Number of Walking Beam suspensions

Number of Bogie suspensions

I 1 2 3 4

Suspension Assembly number

Horizontal Coordinate of suspension with respect to hitch (mm)

Tandem Axle? Yes (1) or No (0).

Spacing between 1st and last nonsteered axle in multiple set (mm)

2772	753			
0	0			
2020	0			

Unsprung Suspension

Unsprung suspension number

Wheel number

Height of wheel center above ground (mm)

Longitudinal length from CG to wheel center (mm)

* SFLAG(I) to be determined

VMS use only

UNCLASSIFIED

UNCLASSIFIED

PROJECT VEHICLE ID _____
 ILTIS

DATE INITIALS
 08/12/86 7.1

7.1 - INDEPENDENT AND WALKING BEAM SUSPENSION

Independent Suspension

Wheel number

Number of the spring force deflection table to be used

Number of the damper force velocity table to be used

Number of the DMC table for positive velocities to be used

Number of the DMC table for negative velocities to be used

Height of wheel center above ground (mm)

Longitudinal length from CG to wheel center (mm)

Walking Beam Suspension

Walking beam suspension number

Number of the spring force deflection table to be used

Number of the damper force velocity table to be used

Number of the DMC table for positive velocities to be used

Number of the DMC table for negative velocities to be used

Longitudinal distance from CG to the pivot point (mm)

Mass moment of inertia (kg • m²)

Beams frictional damping coefficient for resisting rotation

Minimum allowable angle between beam and line from pivot to suspension/frame

Slope of the resisting moment vs. min. allowable angle curve

1	2		
1	2		
1	1		
1	1		
0	0		
0	0		
358	354		
1111	-908		

I

II(I)

IINSTB(I)

IINDTB(I)

INDMTP(I)

INDMTN(I)

ZWHL(II(I))

LWHL(II(I))

K

IWBSTB(K)

IWBDTB(K)

IWDMTP(K)

IWDMTN(K)

LW(K)

WBINRT(K)

WBRDMP(K)

WBPHMN(K)

WBRSTP(K)

PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86
INITIALS _____

7.2 - WALKING BEAM SUSPENSION

Walking Beam (cont'd)

Number of the damper force table to be used with fore outboard damper	IWODTB(1,K)			
Number of the damper force table to be used with aft outboard damper	IWODTB(2,K)			
Number of the DMC table for pos. velocities used with fore outboard damper	IWOMTP(1,K)			
Number of the DMC table for pos. velocities used with aft outboard damper	IWOMTP(2,K)			
Number of the DMC table for neg. velocities used with fore outboard damper	IWOMTN(1,K)			
Number of the DMC table for neg. velocities used with aft outboard damper	IWOMTN(2,K)			
Longitudinal distance from CG to connection point of fore outboard damper to frame	LWDF(1,K)			
Longitudinal distance from CG to connection point of aft outboard damper to frame	LWDF(2,K)			
Longitudinal distance from CG to connection point of fore outboard damper to beam	LWBD(1,K)			
Longitudinal distance from CG to connection point of aft outboard damper to beam	LWBD(2,K)			
Number of the fore wheel	IW(1,K)			
Number of the aft wheel	IW(2,K)			
Height of wheel center above ground (mm)	ZWHL(IW(I,K))			
Longitudinal length from CG to wheel center (mm)	LWHL(IW(I,K))			

PROJECT
VEHICLE ID

ILTIS

DATE
INITIALS

7.3

7.3 - BOGIE SUSPENSION

Bogie

Bogie suspension number

Longitudinal distance from CG to the pivot
point of Bogie

Height of the pivot point from bogie above
ground surface

Orientation angle of bogie's beam with respect
to horizontal

Mass moment of inertia of bogie's beam

Beams frictional damping coefficient for resisting
rotation

Minimum allowable angle between beams and line
from pivot to suspension frame

Slope of the resisting moment vs. minimum
allowable angle curve

Number of the spring force table to be used with
fore outboard damper

Number of the spring force table to be used with
aft outboard damper

Number of the damper force table to be used with
fore outboard damper

Number of the damper force table to be used with
aft outboard damper

Number of the DMC table for pos. velocities used
with fore outboard damper

Number of the DMC table for pos. velocities used
with aft outboard damper

J				
LB(J)				
ZBGPV(J)				
BGANGL(J)				
BGINRT(J)				
BGRDMP(J)				
BGPHMN(J)				
BGRSTP(J)				
IBSTB(1,J)				
IBSTB(2,J)				
IBDTB(1,J)				
IBDTB(2,J)				
IBDMTP(1,J)				
IBDMTP(2,J)				

UNCLASSIFIED

B-17

PROJECT ILTIS
 VEHICLE ID _____

DATE 08/12/86
 INITIALS _____

7.4

7.4 - BOGIE SUSPENSION

Bogie (cont'd)

Number of the DMC table for neg. velocities used
 with fore outboard damper

IBDMTN(1,J)

Number of the DMC table for neg. velocities used
 with aft outboard damper

IBDMTN(2,J)

Longitudinal distance from CG to connection point
 of fore outboard damper to beam

DLB(1,J)

Longitudinal distance from CG to connection point
 of aft outboard damper to beam

DLB(2,J)

Number of the fore wheel

IBB(1,J)

Number of the aft wheel

IBB(2,J)

Height of wheel center above ground (mm)

ZWHL(IBB(I,J))

Longitudinal length from CG to wheel center (mm)

LWHL(IBB(I,J))

Angular limit of travel front road wheel up

BALMU(I)

Angular limit of travel front road wheel down

BALMD(I)

Bogie swing arm width at suspension (mm)

BWIDTH(I)

UNCLASSIFIED

UNCLASSIFIED

B-18

PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86
INITIALS _____

8.0

8.0 - POWER TRAIN DESCRIPTION

Data supplied for: tractive force - speed relationship

: power train characteristics

: both

	IAPG = 2
✓	IAPG = 0
	IAPG = 1

Engine Description: _____

Number of engines	1	NENG	
Number of cylinders/engine	4	NCYL	
Displacement/engine (L)	1.8	CID	
2-cycle diesel: YES		IDIESL = 2	
: NO	✓	IDIESL = 1	
Maximum gross horsepower (kW)			at RPM
Maximum gross torque (Nm)			at RPM
Maximum net horsepower (kW)	55	HPNET	5000
Maximum net torque (Nm)	135	QMAX	2800

Torque converter present? YES

NO

ITRAN = 1, ITVAR = 0

ITRAN = 0, ITVAR = 1

If YES: description/identification

Lock-up capability? YES

NO

LOCKUP = 1

LOCKUP = 0

Sheet 8.1 must be completed. Sheet 8.6 or sheets 8.2, 8.3, 8.4 and 8.5 must also be completed

UNCLASSIFIED

PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86
INITIALS _____

8.1

8.1 - POWER TRAIN ENGINE CHARACTERISTICS

Number of pairs in engine torque relationship

19 IENGIN

Engine torque relationship -- net as installed ENGINE (I,J) J = 1, IENGIN

J	RPM (I = 1)	TORQUE (I = 2)
1	1000	100
2	1400	114
3	1600	119
4	2000	126
5	2400	130
6	2600	132
7	2800	133

J	RPM (I = 1)	TORQUE (I = 2)
8	3000	132
9	3200	130
10	3400	129
11	3600	126
12	3800	123
13	4000	121
14	4400	115

J	RPM (I = 1)	TORQUE (I = 2)
15	4600	112
16	5000	105
17	5400	96
18	5600	92
19	6000	83
20		
21		

Engine to transmission transfer gears present? YES

YES
 NO

ITCASE = 1

ITCASE = 0

If YES: description/identification _____

Gear Ratio :1 TCASE (1)

Efficiency % TCASE (2)

PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86
INITIALS _____

8.2 - POWER TRAIN TRANSMISSION CHARACTERISTICS
AUTOMATIC TRANSMISSION DESCRIPTION

Number of pairs in input RPM vs. speed ratio relationship

0	ICONV1
0	ICONV2
	TQIND

Number of pairs in torque ratio vs. speed ratio relationship

Input torque for input RPM vs. speed ratio relationship (Nm)

CONV1 (I,J) Input RPM vs. Speed Ratio J = 1, ICONV1 CONV2 (I,J) Torque Ratio vs. Speed Ratio J = 1, ICONV2

J	RPM (I = 1)	SPEED RATIO (I = 2)	J	RPM (I = 1)	SPEED RATIO (I = 2)
1			10		
2			11		
3			12		
4			13		
5			14		
6			15		
7			16		
8			17		
9			18		

J	TORQUE (I = 1)	SPEED RATIO (I = 2)	J	TORQUE (I = 1)	SPEED RATIO (I = 2)
1			10		
2			11		
3			12		
4			13		
5			14		
6			15		
7			16		
8			17		
9			18		

STANDARD TRANSMISSION DESCRIPTION
Transmission description/identification

Number of gears 5

Gear number 1 2 3 4 5 6 7 8

Ratio	7.603	3.909	2.277	1.458	1.086			
Efficiency %	.95	.9	.9	.9	.9			

UNCLASSIFIED

B-21

PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86
INITIALS _____

8.3

8.3 - POWER TRAIN FINAL DRIVE AND TRANSFER GEARS

Transmission to final drive transfer gears present? YES NO

✓

If YES: identification/description _____

Number of gears

Can gears be shifted while in motion? YES NO

Gear Number 1 2 3 4

Ratio				
Efficiency %				

Final drive description/identification _____

Locking differential? YES NO

✓
1
✓

LOCDIF = 1
LOCDIF = 0

Number of gears

Can gear be shifted while in motion? YES NO

Gear Number 1 2 3 4

Ratio	5.285			
Efficiency %	.95			

UNCLASSIFIED

PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86
INITIALS _____

8.4

8.4 - POWER TRAIN OVERALL GEAR RATIO COMBINATION
Overall Gear Ratio Combinations

Number of gear ratio combinations

5 NGR

TRANS (I,J)

Gear Ratio Combination	J	1	2	3	4	5	6	7	8	9
Combined Gear Ratio (I = 1)		40.18	20.66	12.03	7.71	5.74				
Combined Efficiency % (I = 2)		.9	.9	.9	.9	.9				

Gear Ratio Combination	J	10	11	12	13	14	15	16	17	18
Combined Gear Ratio (I = 1)										
Combined Efficiency % (I = 2)										

Gear Ratio Combination	J	19	20	21	22	23	24	25	26	27
Combined Gear Ratio (I = 1)										
Combined Efficiency % (I = 2)										

Combined final drive ratio 27.94 FD(1)

Combined final drive efficiency 0.9 FD(2)

For final input to NRMM all gear ratio combinations should be assigned to the transmission with only a single final drive and transfer case ratio and efficiency. TRANS (I,J) may be used to show the combined overall gear ratios and efficiencies as input for NRMM.

PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86
INITIALS _____

8.5 - POWER TRAIN TRACTIVE EFFORT VS. SPEED RELATION

Tractive Effort vs. Speed Relationship POWER (I,J)

Number of pairs in tractive effort vs. speed relationship

0 IPOWER

J	SPEED km/h (I = 1)	FORCE N (I = 2)	GEAR
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

J	SPEED km/h (I = 1)	FORCE N (I = 2)	GEAR
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			

J	SPEED km/h (I = 1)	FORCE N (I = 2)	GEAR
33			
34			
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			

Supply at least 4 pairs for each gear - final drive combination

UNCLASSIFIED

B-24

PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86
INITIALS _____

9.0

9.0 - SPEED LIMITED BY OBSTACLE IMPACT

Number of height values used in the obstacle height vs. speed table
Number of obstacle spacing values used in the obstacle spacing vs. speed table
Uniform obstacle height used in the obstacle spacing vs. speed table

NHVALS
NSVALS

OBSTACLE HEIGHT VS. SPEED

N H V A L S	Obstacle Height HVALS (I)	Maximum Speed VOOB(I)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

OBSTACLE SPACING VS. SPEED

N S V A L S	Obstacle Spacing SVALS(I)	Maximum Speed VOOBS(I)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

UNCLASSIFIED

UNCLASSIFIED

B-25

PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86
INITIALS _____

9.1

9.1 - SPEED LIMITED BY ROUGHNESS

Number of RMS entries

Number of tolerance levels

MAXIPR

MAXL

Tolerance level number

Power level (watts)

	1	2	3
M A X I P R	RMS (mm)	Speed (km/h)	Speed (km/h)
1	RMS(I)	VRIDE(I, J)	VRIDE (I, 3)
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

UNCLASSIFIED

UNCLASSIFIED

B-26

PROJECT ILTIS
VEHICLE ID _____

DATE 08/12/86
INITIALS _____

10.0

10.0 - EXTRAS AND DOUBLES

CGZ = CGH
ZCG = CGH
NUNITS = 1
NTRKS = 0
NUEH1 = 1
NUEH(I) = 1

IFSEAT = 1

1 2 3 4

Axle Number

Load under wheel (N)

Deflection of point from force-deflection rel.

Force of point from force-deflection rel.

Undelected tire diameter (mm)

Effective radius of tire (mm)

1	2	3	4
1	2		
3715	4890		
12	16		
3715	4890		
740	740		
370	370		

Suspension Assembly Number

Powered (1) or unpowered (0) axle: wheel 1

wheel 2

Braked (1) or unbraked (0) axle: wheel 1

wheel 2

Suspension type: 0 - independent or 1 - bogie

Equilibrium load on suspension assembly (N)

1 2 3 4

1	2	3	4
1	2		
1	1		
0	0		
1	1		
0	0		
0	0		
3550	3340		

UNCLASSIFIED

UNCLASSIFIED

ANNEX C

SUMMARIES OF TERRAIN FEATURES OF FRG AND CFB PETAWAWA
OFF-ROAD TERRAIN TRANSECTS

UNCLASSIFIED

Characteristics of Off-Road Terrain Units

1. terrain unit number
2. soil type (fine grained, coarse grained, CH)
3. soil strength (RCI) - dry season
4. soil strength (RCI) - average season
5. soil strength (RCI) - wet season
6. topographic slope (percent)
7. obstacle approach angle (degrees)
8. obstacle height (inches)
9. obstacle width (inches)
10. obstacle length (feet)
11. obstacle spacing (feet)
12. obstacle spacing type (avoidable or non-avoidable)
13. surface roughness (rms inches)
14. spacing of vegetation in class size 1 (in feet)
15. spacing of vegetation in class size 2 (in feet)
16. spacing of vegetation in class size 3 (in feet)
17. spacing of vegetation in class size 4 (in feet)
18. spacing of vegetation in class size 5 (in feet)
19. spacing of vegetation in class size 6 (in feet)
20. spacing of vegetation in class size 7 (in feet)
21. spacing of vegetation in class size 8 (in feet)
22. recognition distance
23. area of terrain unit (square miles)

Characteristics of Road Segments

1. road segment number
2. road type (super highway, primary road, secondary road, trail)
3. soil type (fine grained, coarse grained, CH)
4. urban code
5. soil strength (RCI) - dry season
6. soil strength (RCI) - average season
7. soil strength (RCI) - wet season
8. soil strength (RCI) - wet, wet season
9. topographic slope (percent)
10. recognition distance (feet)
11. surface roughness (rms inches)
12. AASHO curvature speed limit (miles/hour)
13. length of road segment (miles)

CFB Petawawa Transect

Number of Units 780

Total Area 459800.000

<u>Type</u>	<u>Title</u>	<u>No. of Units</u>	<u>Surface Area</u>	<u>% of Total Area</u>
-------------	--------------	---------------------	---------------------	------------------------

**** SOIL TYPE ****

Fine-Grained		0	.00	.0
Coarse-Grained		599	401950.00	87.4
Muskeg		181	57850.00	12.6
CH		0	.00	.0

**** RMS ROUGHNESS (INCHES) ****

1	0.0 - 0.5	269	96225.00	20.9
2	0.6 - 1.5	147	146050.00	31.8
3	1.6 - 2.5	364	217525.00	47.3
4	2.6 - 3.5	0	.00	.0
5	3.6 - 4.5	0	.00	.0
6	4.6 - 5.5	0	.00	.0
7	5.6 - 6.5	0	.00	.0
8	6.6 - 7.5	0	.00	.0
9	> 7.5	0	.00	.0

**** SLOPE (PERCENT) ****

1	0.0 - 2.0	555	415775.00	90.4
2	2.1 - 5.0	46	13300.00	2.9
3	5.1 - 10.0	50	6925.00	1.5
4	10.1 - 20.0	35	9325.00	2.0
5	20.1 - 40.0	61	10300.00	2.2
6	40.1 - 60.0	30	3825.00	.8
7	60.1 - 70.0	3	350.00	.1
8	> 70.	0	.00	.0

**** SOIL STRENGTH (RCI) ** DRY SEASON**

1	> 280	75	23950.00	5.2
2	221 - 280	93	24750.00	5.4
3	161 - 220	56	59950.00	13.0
4	101 - 160	1	25.00	.0
5	61 - 100	8	5450.00	1.2
6	41 - 60	192	197775.00	43.0
7	33 - 40	178	90725.00	19.7
8	26 - 32	17	1550.00	.3
9	17 - 25	94	32450.00	7.1
10	11 - 16	66	23175.00	5.0
11	0 - 10	0	.00	.0

CFB Petawawa Transect

<u>Type</u>	<u>Title</u>	<u>No. of Units</u>	<u>Surface Area</u>	<u>% of Total Area</u>
-------------	--------------	---------------------	---------------------	------------------------

** SOIL STRENGTH (RCI) ** AVERAGE SEASON

1	> 280	0	.00	.0
2	221 - 280	75	23950.00	5.2
3	161 - 220	93	24750.00	5.4
4	101 - 160	56	59950.00	13.0
5	61 - 100	1	25.00	.0
6	41 - 60	8	5450.00	1.2
7	33 - 40	192	197775.00	43.0
8	26 - 32	178	90725.00	19.7
9	17 - 25	17	1550.002	.3
10	11 - 16	94	32450.00	7.1
11	0 - 10	66	23175.00	5.0

** SOIL STRENGTH (RCI) ** WET SEASON

1	> 280	0	.00	.0
2	221 - 280	0	.00	.0
3	161 - 220	75	23950.00	5.2
4	101 - 160	93	24750.00	5.4
5	61 - 100	56	59950.00	13.0
6	41 - 60	1	25.00	.0
7	33 - 40	8	5450.00	1.2
8	26 - 32	192	197775.00	43.0
9	17 - 25	178	90725.00	19.7
10	11 - 16	17	1550.00	.3
11	0 - 10	160	55625.00	12.1

** VISIBILITY (FEET) **

1	> 164.0	191	211600.00	46.0
2	79.1 - 164.0	212	43500.00	9.5
3	39.7 - 79.0	164	56100.00	12.2
4	29.9 - 39.8	213	148600.00	32.3
5	20.0 - 29.8	0	.00	.0
6	10.2 - 15.0	0	.00	.0
7	10.2 - 15.0	0	.00	.0
8	5.2 - 10.1	0	.00	.0
9	0.0 - 5.1	0	.00	.0

** OBSTACLE WIDTH (INCHES) **

1	> 47.2	48	30225.00	6.6
2	35.8 - 47.1	0	.00	.0
3	24.0 - 35.7	0	.00	.0
4	12.2 - 23.9	0	.00	.0
5	0.0 - 12.1	732	429575.00	93.4

CFB Petawawa Transect

<u>Type</u>	<u>Title</u>	<u>No. of Units</u>	<u>Surface Area</u>	<u>% of Total Area</u>
** OBSTACLE SPACING TYPE **				
Avoidable		780	459800.00	100.0
Non-Avoidable		0	.00	.0
** OBSTACLE LENGTH (FEET) **				
1	0.0 - 1.	279	243025.00	52.9
2	1.1 - 3.	0	.00	.0
3	3.4 - 6.	0	.00	.0
4	6.7 - 9.	0	.00	.0
5	10.0 - 19.	501	216775.00	47.1
6	19.8 - 492.	0	.00	.0
7	> 492.0	0	.00	.0
** OBSTACLE SPACING (FEET) **				
1	Bare	279	243025.00	52.9
2	65.9 - 196.9	103	36550.00	7.9
3	36.4 - 65.8	398	180225.00	39.2
4	26.6 - 36.3	0	.00	.0
5	18.4 - 26.5	0	.00	.0
6	13.5 - 18.3	0	.00	.0
7	8.5 - 13.4	0	.00	.0
8	0.0 - 8.4	0	.00	.0
** APPROACH ANGLE **				
1	178.6 - 180.0	780	459800.00	100.0
2	180.0 - 181.5	0	.00	.0
3	175.6 - 178.5	0	.00	.0
4	181.5 - 184.5	0	.00	.0
5	170.1 - 175.5	0	.00	.0
6	184.5 - 190.0	0	.00	.0
7	158.1 - 170.0	0	.00	.0
8	190.1 - 202.0	0	.00	.0
9	149.1 - 158.0	0	.00	.0
10	202.1 - 211.0	0	.00	.0
11	135.1 - 149.0	0	.00	.0
12	211.1 - 225.0	0	.00	.0
13	90.0 - 135.0	0	.00	.0
14	> 225.0	0	.00	.0

Germany Transect

Number of Units 481

Total Area 100.220

<u>Type</u>	<u>Title</u>	<u>No. of Units</u>	<u>Surface Area</u>	<u>% of Total Area</u>
** SOIL TYPE **				
Fine-Grained		481	100.22	100.0
Coarse-Grained		0	.00	.0
Muskeg		0	.00	.0
CH		0	.00	.0
** RMS ROUGHNESS (INCHES) **				
1	0.0 - 0.5	1	.03	.0
2	0.6 - 1.5	335	77.40	77.2
3	1.6 - 2.5	70	16.85	16.8
4	2.6 - 3.5	74	5.94	5.9
5	3.6 - 4.5	0	.00	.0
6	4.6 - 5.5	0	.00	.0
7	5.6 - 6.5	0	.00	.0
8	6.6 - 7.5	1	.00	.0
9	> 7.5	0	.00	.0
** SLOPE (PERCENT) **				
1	0.0 - 2.0	11	1.75	1.7
2	2.1 - 5.0	100	28.26	28.2
3	5.1 - 10.0	126	27.89	27.8
4	10.1 - 20.0	116	24.83	24.8
5	20.1 - 40.0	98	13.68	13.7
6	40.1 - 60.0	25	3.64	3.6
7	60.1 - 70.0	5	.17	.2
8	> 70.	0	.00	.0
** SOIL STRENGTH (RCI) ** DRY SEASON				
1	> 280	454	96.71	96.5
2	221 - 280	2	.06	.1
3	161 - 220	25	3.45	3.4
4	101 - 160	0	.00	.0
5	61 - 100	0	.00	.0
6	41 - 60	0	.00	.0
7	33 - 40	0	.00	.0
8	26 - 32	0	.00	.0
9	17 - 25	0	.00	.0
10	11 - 16	0	.00	.0
11	0 - 10	0	.00	.0

Germany Transect

<u>Type</u>	<u>Title</u>	<u>No. of Units</u>	<u>Surface Area</u>	<u>% of Total Area</u>
-------------	--------------	---------------------	---------------------	------------------------

** SOIL STRENGTH (RCI) ** AVERAGE SEASON

1	> 280	69	20.79	20.7
2	221 - 280	232	37.20	37.1
3	161 - 220	21	1.08	1.1
4	101 - 160	134	37.70	37.6
5	61 - 100	0	.00	.0
6	41 - 60	25	3.45	3.4
7	33 - 40	0	.00	.0
8	26 - 32	0	.00	.0
9	17 - 25	0	.00	.0
10	11 - 16	0	.00	.0
11	0 - 10	0	.00	.0

** SOIL STRENGTH (RCI) ** WET SEASON

1	> 280	0	.00	.0
2	221 - 280	0	.00	.0
3	161 - 220	0	.00	.0
4	101 - 160	301	57.99	57.9
5	61 - 100	21	1.08	1.1
6	41 - 60	134	37.70	37.6
7	33 - 40	25	3.45	3.4
8	26 - 32	0	.00	.0
9	17 - 25	0	.00	.0
10	11 - 16	0	.00	.0
11	0 - 10	0	.00	.0

** VISIBILITY (FEET) **

1	> 164.0	0	.00	.0
2	79.1 - 164.0	410	75.02	74.9
3	39.7 - 79.0	0	.00	.0
4	29.9 - 39.8	59	24.52	24.5
5	20.0 - 29.8	0	.00	.0
6	15.1 - 19.9	6	.29	.3
7	10.2 - 15.0	6	.39	.4
8	5.2 - 10.1	0	.00	.0
9	0.0 - 5.1	0	.00	.0

** OBSTACLE WIDTH (INCHES) **

1	> 47.2	71	25.69	25.6
2	35.8 - 47.1	2	.06	.1
3	24.0 - 35.7	63	3.91	3.9
4	12.2 - 23.9	146	54.83	54.7
5	0.0 - 12.1	199	15.73	15.7

Germany Transect

<u>Type</u>	<u>Title</u>	<u>No. of Units</u>	<u>Surface Area</u>	<u>% of Total Area</u>
** OBSTACLE HEIGHT (INCHES) **				
1	0.0 - 5.9	174	16.03	16.0
2	6.0 - 9.8	182	56.15	56.0
3	9.9 - 13.8	97	26.64	26.6
4	13.9 - 14.2	15	.86	.9
5	14.3 - 23.6	4	.14	.1
6	23.7 - 33.5	1	.12	.1
7	> 33.5	8	.28	.3

**** OBSTACLE SPACING TYPE ****

Avoidable	364	77.73	77.6
Non-Avoidable	117	22.49	22.4

**** OBSTACLE LENGTH (FEET) ****

1	0.0 - 1.	31	4.75	4.7
2	1.1 - 3.	0	.00	.0
3	3.4 - 6.	0	.00	.0
4	6.7 - 9.	0	.00	.0
5	10.0 - 19.	80	26.02	26.0
6	19.8 - 492.	253	46.96	46.9
7	> 492.0	117	22.49	22.4

**** OBSTACLE SPACING (FEET) ****

1	Bare	205	37.74	37.7
2	65.9 - 196.9	99	6.26	6.2
3	36.4 - 65.8	9	.42	.4
4	26.6 - 36.3	0	.00	.0
5	18.4 - 26.5	2	.06	.1
6	13.5 - 18.3	0	.00	.0
7	8.5 - 13.4	0	.00	.0
8	0.0 - 8.4	166	55.74	55.6

Germany Transect

<u>Type</u>	<u>Title</u>	<u>No. of Units</u>	<u>Surface Area</u>	<u>% of Total Area</u>
** APPROACH ANGLE **				
1	178.6 - 180.0	5	.24	.2
2	180.0 - 181.5	0	.00	.0
3	175.6 - 178.5	68	5.75	5.7
4	181.5 - 184.5	0	.00	.0
5	170.1 - 175.5	135	9.31	9.3
6	184.5 - 190.0	0	.00	.0
7	158.1 - 170.0	70	25.13	25.1
8	190.1 - 202.0	0	.00	.0
9	149.1 - 158.0	142	53.92	53.8
10	202.1 - 211.0	0	.00	.0
11	135.1 - 149.0	18	.81	.8
12	211.1 - 225.0	0	.00	.0
13	90.0 - 135.0	3	.11	.1
14	> 225.0	40	4.95	4.9

UNCLASSIFIED

ANNEX D

MEASUREMENT OF WEIGHT SUPPORTED BY TIRES AT FORDING DEPTH

UNCLASSIFIED

The weight supported by the tires of an Iltis (laden), while fording through water 533 mm in depth, was determined by suspending the vehicle in a sling with a single cable and by performing the following:

1. Weight of Iltis and sling prior to immersion	2140 kg
2. Weight of Iltis and sling when vehicle immersed to fording depth	1492 kg
3. Buoyant force of water (#1 minus #2)	648 kg
4. Weight of Iltis without sling	1755 kg
5. Weight of Iltis when fording (#4 minus #3)	1107 kg
6. Percent of weight supported by front tires	43
7. Fording weight supported by front tires (#5 multiplied by #6)	757 kg
8. Fording weight supported by rear tires (#5 minus #7)	998 kg

Note: Items 7 and 8 assume the weight ratio among the axles is the same for an Iltis when fording as it is when not fording.

UNCLASSIFIED

ANNEX E

MEASUREMENTS OF AERODYNAMIC DRAG COEFFICIENT

UNCLASSIFIED

The aerodynamic drag coefficient was measured in the 30 foot wind tunnel at the National Research Council in Ottawa, Ontario. Experiments were performed at wind speeds of 30 km/hr to 140 km/hr. The aerodynamic drag coefficients appear in the table below. The variations in drag coefficient at different speeds are believed to have been caused by changes in the shape of the tarpaulin and upward pitching of the vehicle due to aerodynamic lift and drag.

The value of drag coefficient used in simulation runs is $CD = 0.537$.

Wind Speed ± 5 km/hr	Aerodynamic Drag Coefficient (CD)
30	0.456
40	0.561
50	0.551
60	0.546
70	0.539
80	0.533
90	0.533
100	0.523
120	0.526
140	0.525

UNCLASSIFIED

ANNEX F

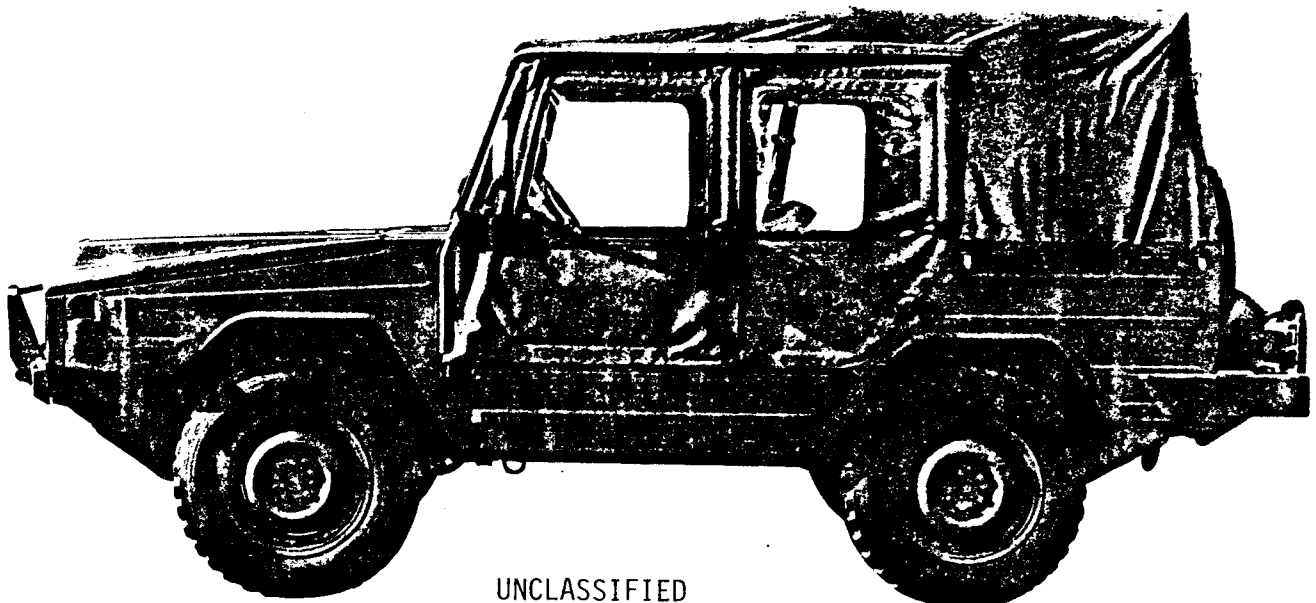
SUSPENSION AND POWER TRAIN CHARACTERISTICS RECEIVED FROM BOMBARDIER

UNCLASSIFIED



Bombardier Iltis*

4x4 - 0.5 ton



Bombardier Itis – Technical Data

Engine:	METRIC	IMPERIAL
Model	VW 049	
Type	4 cylinder four stroke gasoline engine	
Displacement	1.7 litre • 1714 cm ³	105 in. ³
Bore and stroke	79.5 x 86.4 mm	3.13 x 3.40 in.
Compression ratio	8.2 : 1	
Fuel	gasoline low octane (regular)	
Fuel capacity	85 litres	18.7 imp. gal.)
Horsepower maximum	55 kW @ 5,000 RPM (74 HP)	
Torque: maximum net	135 N·m @ 2800 RPM	100 lbs/ft.
Crankcase capacity	4.0 l w/o filter change	3.5 imp. qts.
	4.5 l w filter change	4.0 imp. qts.
Cooling system capacity	7.5 litres	1.6 imp. gal.
Carburetor	Solex 1B1 with thermostarter	
Cooling fan	two thermostatically controlled electric fans: diameter 280 mm	
		11 in.

Transmission:

Type	manual gearbox with integrated differential, dry single plate clutch	
Model	VW 005	
Number of speeds: forward	5	
reverse	1	
Gear ratios:		
1st	3.909	
2nd	2.277	
3rd	1.458	
4th	1.086	
reverse	7.318 not synchronized	
cross-country gear	7.603 not synchronized	
Final drive ratio	37: 7 = 5.286	
Lubricant capacity	3.6 litres	3.2 imp. qts.

Axles and Differentials:

Front:	differential included in transmission	
type	single reduction	
ratio	5.285	
– manually controlled from inside cab		
– differential lock optional - controlled manually from inside cab		
– wheels driven by 2 drive shafts with constant velocity joints		
Rear:	single reduction	
type	single reduction	
ratio	5.285	
lubricant capacity	1.2 l w/o differential lock	1.0 imp. qt.
	1.6 l w differential lock	1.4 imp. qt.
– rear differential always in operation		
– differential lock optional - controlled manually from inside cab		
– wheels driven by 2 drive shafts with constant velocity joints		

Frame:

Type	ladder (side rails and crossmembers)	
Side members	closed box section	
Number of crossmembers	4 transverse bracings	
	2 spring carriers	
	1 bolt-on crossmember in front	

Electrical system:

Waterproof	yes
Radio suppressed	yes
Voltage	24 V
Alternator rating	55 A
Number of batteries	2

Steering:

Type	rack and pinion (maintenance free)
Ratio	19.44

Brakes:

Type	hydraulic dual circuit diagonally split	
Dimensions:		
front	drum 280 mm	11.02 in.
rear	drum 280 mm	11.02 in.
Total effective area per wheel:		
front	225.2 cm ²	34.9 in. ²
rear	225.2 cm ²	34.9 in. ²
Actuation	hydraulic with vacuum power unit	
Parking brake type	mechanical acting on rear wheel	

Suspension:

Type (front and rear)	independent wheel suspension on twin control arms
-----------------------	---

Springs:

Type (front and rear)	multi-leaf semi-elliptic transversal springs and polyurethane supplementary spring on double action shock absorbers
Size (length x width)	97 cm x 7 cm approx. 38.18 in. x 2.75 in. approx.
Number of leaves	4
Rate	73.8 kN/m 422 lbs/in

Tires:

Size	6.50 R 16
Type	cross-country radial tires

Dimensions:

	METRIC	IMPERIAL
Exterior		
• overall length	3954 mm	155.7 in.
• overall width w/o mirror	1520 mm	59.8 in.
• overall height - no load	1837 mm	72.3 in.
• wheelbase	2017 mm	79.4 in.
• tires - front/rear track	1230/1260 mm	42.4/49.6 in.
• turning radius	11 m	36.08 ft.
• road area	5.9 m ²	65.5 ft. ²
• ground clearance		
– under frame	330 mm	13 in.
– under front axle	250 mm	9.8 in.
– under rear axle	250 mm	9.8 in.
– under front bumper	588 mm (no load)	23.1 in.
– under rear bumper	590 mm (no load)	23.2 in.
• fording depth	600 mm	23.6 in.
• angle of approach/departure	41.5°/32.5°	
• ramp angle	32°	
• rollover lateral resistance	37°	
• Shipping dimensions:		
minimum reducible height	1370 mm	53.9 in.

• Shipping cubic at min reducible height	8.2 m ³	288 ft ³
• Shipping cubic at std. dimensions	11 m ³	388 ft. ³
Interior		
• front		
– door to door (seat height)	1413 mm	55.6 in.
– door to door (shoulder height)	1450 mm	57.1 in.
• maximum height	1130 mm	44.5 in.
• headroom front/rear	1020/920 mm	40.2/36.2 in.
• seat width front/rear	1413/970 mm	55.6/38.2 in.
• shoulder height width front/rear	1450/1370 mm	57.0/53.9 in.
• seat height front/rear	363/363 mm	14.3/14.3 in.
• length of load area	400 mm	15.8 in.
• length of load area to frontseat backrest	1120 mm	44.1 in.
• width of load area	1370 mm	53.9 in.
• load area		
– rear seats up	0.55 m ²	5.9 ft ²
– rear seats folded	1.33 m ²	14.3 ft ²

Weights:

Unladen weight	1550 kg (depending on equipment)	3417 lbs
Payload	500 kg	1102 lbs
Total weight	2050 kg	4519 lbs
Permissible axle load:		
front	1000 kg	2200 lbs
rear	1250 kg	2756 lbs
Permissible trailer load:		
braked	2000 kg	4400 lbs
unbraked	750 kg	1653 lbs
Tongue weight (trailer)	75 kg	165 lbs

Performance:

Top speed	130 km/h	80 mi./h
Minimum speed	4 km/h	2.5 mi./h
Cruising range	700 km	435 mi.
Fuel consumption		
– in town cycle	14.6 l/100 km	19.3 mi./imp. gal.
– at constant 90 km/h	10.5 l/100 km	26.9 mi./imp. gal.
– at constant 120 km/h	15.0 l/100 km	18.8 mi./ imp. gal.
Climbing ability fully laden:		
1st gear	32.0%	
2nd gear	16.8%	
3rd gear	9.2%	
4th gear	5.3%	
Reverse gear	72.5%	
Cross-country gear	77.0%	
Climbing ability fully laden (total vehicle weight) and 750 kg trailer weight:		
1st gear	22%	
Cross-country gear	48%	
Climbing ability fully laden and 2000 kg trailer weight:		
1st gear	15%	
Cross-country gear	32%	

TOOLS and PUBLICATIONS

Each vehicle is equipped with one of each of the following items:

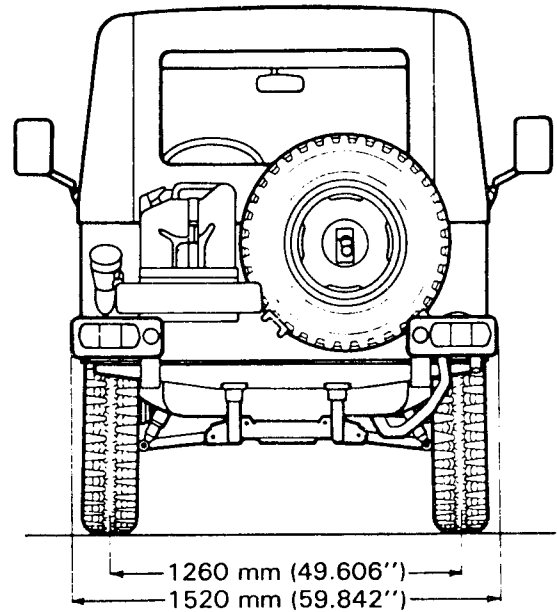
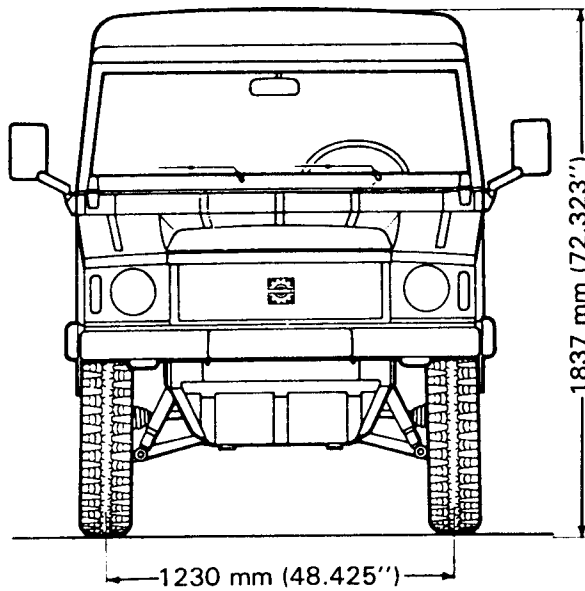
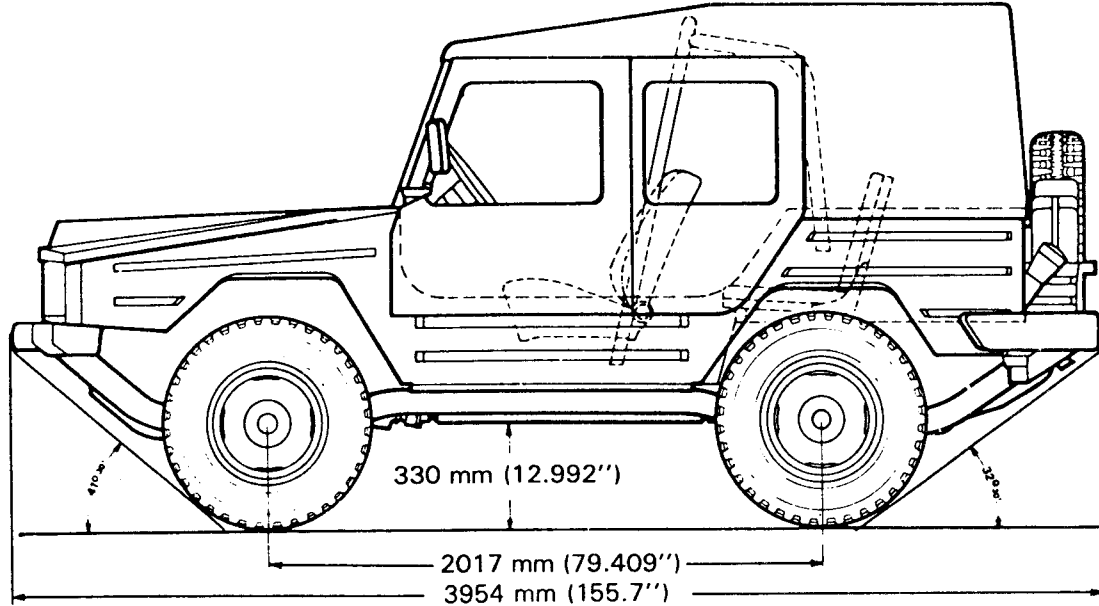
TOOLS

Pliers slip joint
Screwdriver flat tip
Screwdriver Phillips #2
Wrench drain plug for transmission and differential
Wheel socket
Bar wheel socket
Guide pin wheel changing
Tool bag
Jack support
Jack

PUBLICATIONS

Operator's Manual
Lubrication Chart

BOMBARDIER ILTIS - DIMENSIONS



Bombardier Inc. reserves the right at any time to change specifications, design, features, models or equipment without incurring obligations.

B183 000 055

* Trademark of Bombardier Inc.
Litho'd in Canada.



Bombardier Inc.
Logistic Equipment Division

Valcourt, Que., Canada, JOE 2LO
Telephone (514) 532-2211
Cable Bombarsnow, Telex 05-832575

SAMPLE COMPUTATIONSUSPENSION DATA - ILTISA. Springs

Reference : Drawing no.B183 411 103

On the diagram, the constant for fixed spring is : $C=79.0 \text{ N/mm}$

Constant: $1 \text{ lb}_f = 4.448 \text{ N}$

$1 \text{ in} = 25.4 \text{ mm}$

Hence : $C = 451.1 \text{ lb}_f/\text{in}$

Remark: - $F = 0 \text{ N}$ is rest position (+112 mm displacement)

- $F = 3200 \text{ N}$ (719 lb_f) is the estimated weight on a front wheel *

- $F = 7600 \text{ N}$ (1709 lb_f) is the estimated weight on a rear wheel *

- The value of "C" is the same for front & rear, loaded or unloaded.

* based on a hypothetical distribution of the total weight for a German Iltis.

B. Shock Absorbers

Reference : Drawing No TAB 010 125

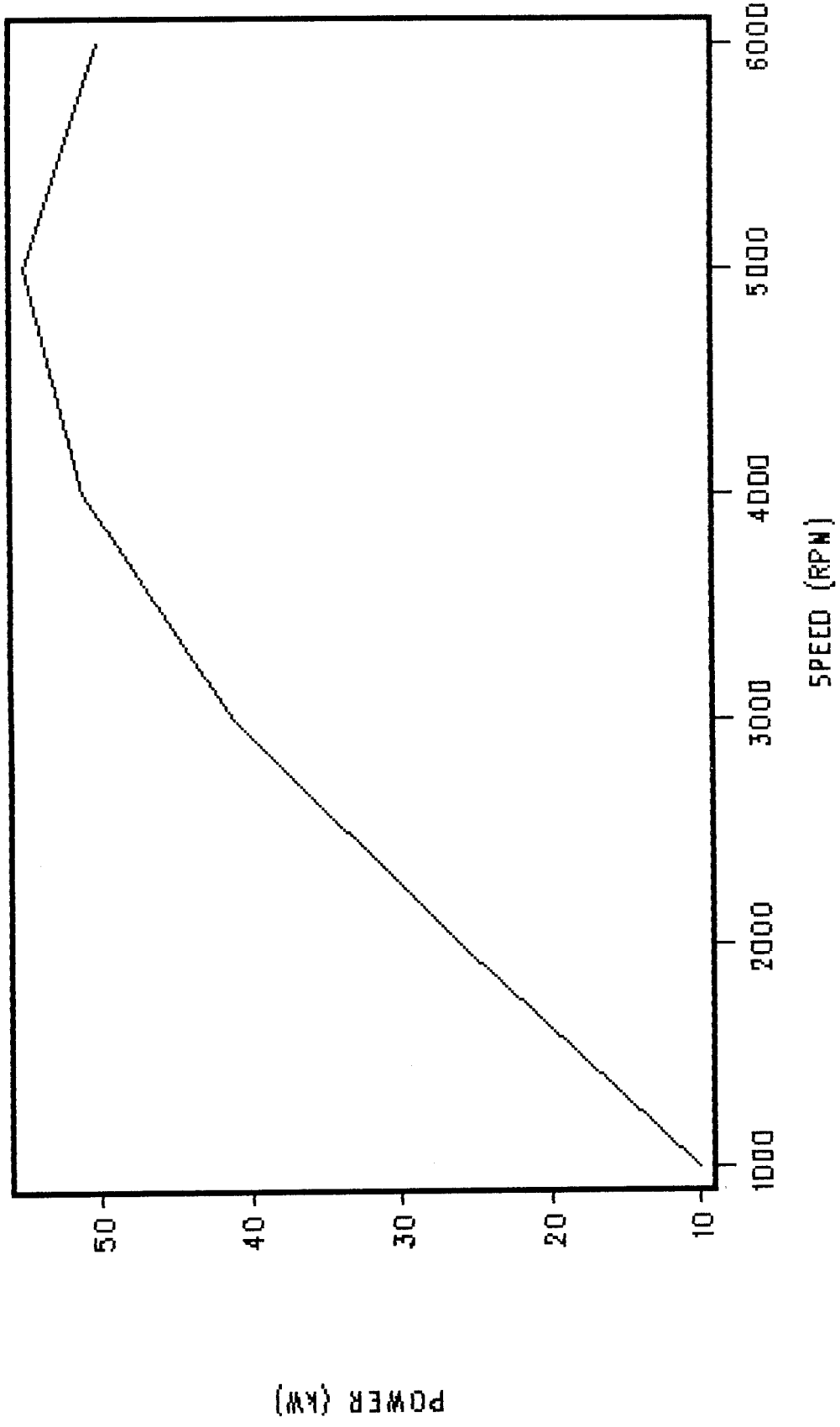
For shock absorber part no. B183 413 031 0Z

Conversion : Deflection rate (in/sec) where 1 cycle = 2 strokes

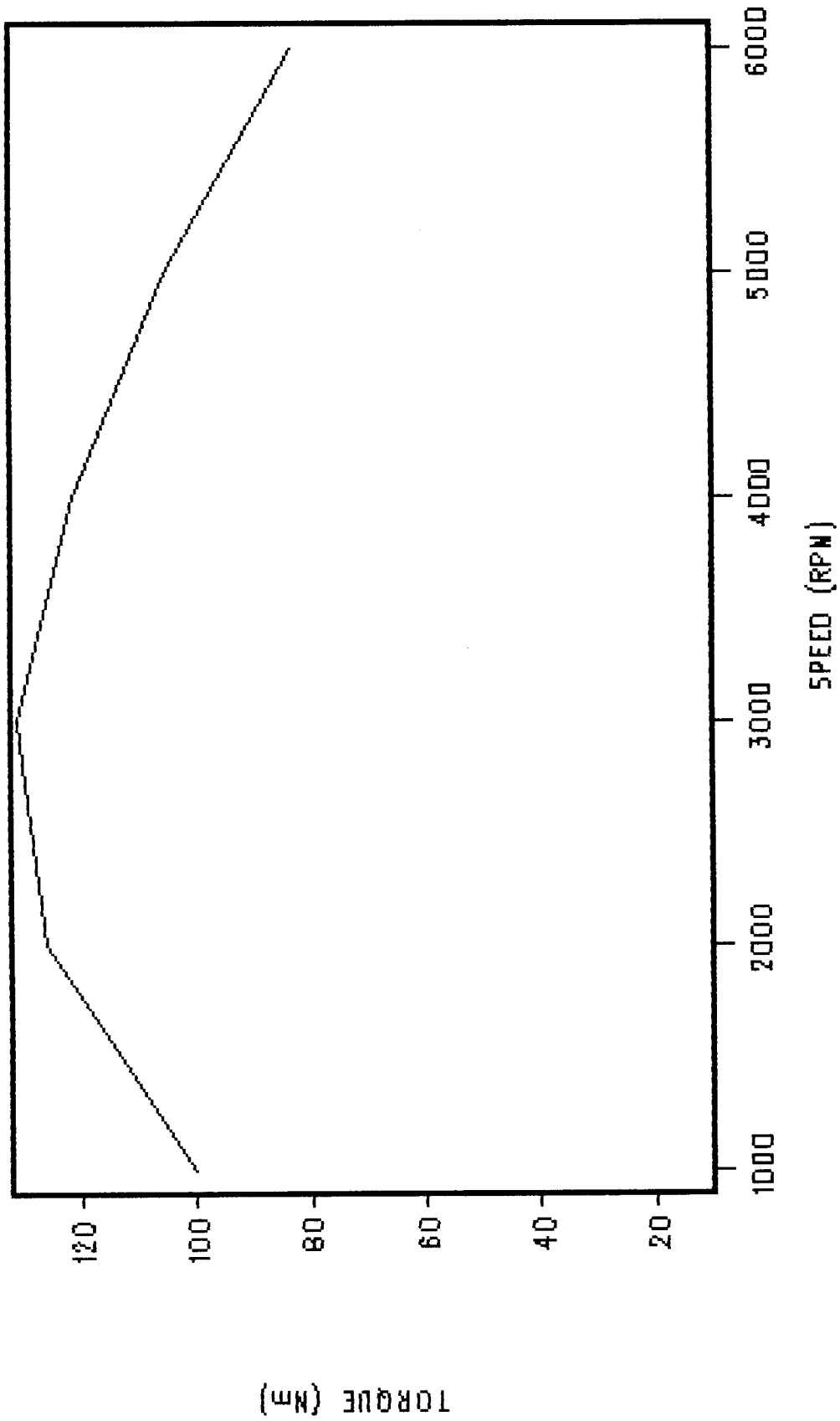
Then : $2 \times \text{stroke (mm)} \times 100 \text{ CPM} \times \frac{1 \text{ in}}{25.4 \text{ mm}} \times \frac{1 \text{ min}}{60 \text{ sec}} = \frac{\text{Deflection}}{\text{rate}} \frac{\text{in}}{\text{sec}}$

Interpretation: - Pull step = force unloading

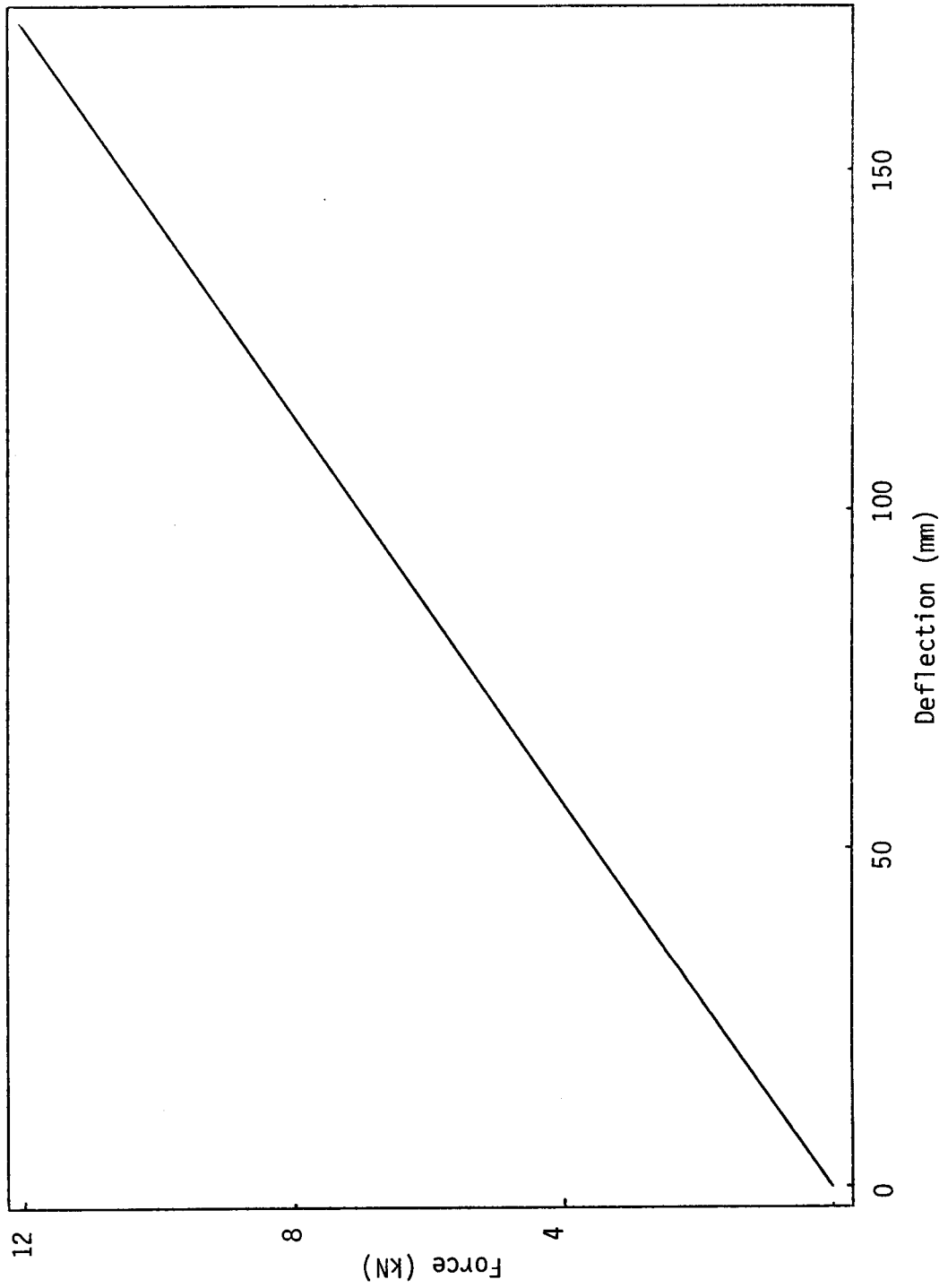
- Compression step = force loading



Power versus speed curve for VW - Iltis engine (displacement = 1.7ℓ)



Torque versus speed curve for VW - Iltis engine (displacement = 1.7ℓ)



Force - deflection curve for Ilitis leaf spring

UNCLASSIFIED

	Stroke (mm)	10	25	50	75
SHOCK ABSORBER IDENTIFICATION NUMBER	C.P.M. (min^{-1})	100	100	100	100
B183 400 021	extension force (N)	850	2180 ± 200	2550 ± 220	2780 ± 250
	compression force (N)	360	850 ± 110	1130 ± 110	1320 ± 140

- Notes: 1. Damping tested at $20^{\circ} \pm 2^{\circ}\text{C}$
2. Hydraulic stop, $3800 \pm 400\text{N}$

Extension and compression forces for Iltis shock absorber when cycled
using various stroke lengths

UNCLASSIFIED

UNCLASSIFIED

ANNEX G

NRMM TERRAIN UNIT SPEED PREDICTIONS

UNCLASSIFIED

The basic output of the NATO Reference Mobility Model for areal terrain units consists of the following (as it appears on the next 11 pages of this Annex):

- 1) Terrain unit number, NTU
- 2) Terrain type, ITUT
 - 1 - normally dry patch
 - 2 - marsh or other water covered patch
 - 11 - superhighway
 - 12 - primary road
 - 13 - secondary road
 - 14 - trail
- 3) The omnidirectional speed-made-good attainable by the vehicle in the terrain unit, VMAX (this is a harmonic average of 4, 5, and 6 below)
- 4) The attainable speed-made-good going with the topographic slope (up grade)
- 5) The attainable speed-made-good on the level across the grade)
- 6) The attainable speed-made-good going against the topographic slope (down grade)
- 7) The selected omnidirectional speed-made-good which considers both the vehicle capabilities and human factors, VSEL
- 8) The selected speed-made-good up grade
- 9) The selected speed-made-good across the grade
- 10) The selected speed-made-good down grade
- 11) Grade (topographic slope)
- 12) Area of the terrain unit.

Columns 13 through 20 present the same information given in columns 3 through 10 but in units of kilometers per hour rather than miles per hour. Column 21 is identical to column 1. It is repeated for ease of reading values in the table.

Note that the predicted speeds presented in columns 4, 5, and 6 as well as those in columns 8, 9, and 10 will be different only if slope is the speed limiting factor. Note also that the speed prediction listed as applying to operation on the level actually refers to operation across the slope. In other words, the vehicle is assumed to be operating on a side slope but not climbing or descending a grade.

13:42 MAY 10 '88 ILT_FRG_OFFRD_DRY:NOUT.VMS008U0

1 NTU		ITUT		VMAX		UP LEVEL		DOWN		VSEL		UP LEVEL		DOWN		VSEL		UP LEVEL		DOWN		NTU	
						MI./HR.				MI./HR.				KM./HR.				KM./HR.					
4	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	3.50	0.0100	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	4
5	1	8.43	8.43	0.00	0.00	8.43	8.43	0.00	0.00	3.50	0.0700	13.57	13.57	0.00	0.00	13.57	13.57	0.00	0.00	13.57	13.57	0.00	5
10	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	3.50	0.3300	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	10
14	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	3.50	0.0600	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	14
19	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	3.50	0.1100	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	19
20	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	3.50	0.0700	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	20
23	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	3.50	0.0100	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	23
24	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	3.50	1.7300	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	24
25	1	8.43	8.43	0.00	0.00	8.43	8.43	0.00	0.00	3.50	0.1500	13.57	13.57	0.00	0.00	13.57	13.57	0.00	0.00	13.57	13.57	0.00	25
26	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	3.50	0.1200	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	26
27	1	2.05	2.05	0.00	0.00	2.05	2.05	0.00	0.00	3.50	0.0100	3.30	3.30	0.00	0.00	3.30	3.30	0.00	0.00	3.30	3.30	0.00	27
32	1	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	7.50	0.3400	11.99	11.99	0.00	0.00	11.99	11.99	0.00	0.00	11.99	11.99	0.00	32
33	1	8.43	8.43	0.00	0.00	8.43	8.43	0.00	0.00	7.50	0.0200	13.57	13.57	0.00	0.00	13.57	13.57	0.00	0.00	13.57	13.57	0.00	33
37	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	7.50	0.1800	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	37
38	1	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	7.50	0.0900	11.99	11.99	0.00	0.00	11.99	11.99	0.00	0.00	11.99	11.99	0.00	38
41	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	7.50	0.0000	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	41
42	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	7.50	0.3600	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	42
45	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	7.50	0.2200	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	45
48	1	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	7.50	0.0800	11.99	11.99	0.00	0.00	11.99	11.99	0.00	0.00	11.99	11.99	0.00	48
52	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	7.50	0.1200	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	52
53	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	7.50	2.4500	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	53
55	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	7.50	0.6300	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	55
58	1	2.05	2.05	0.00	0.00	2.05	2.05	0.00	0.00	7.50	0.2200	3.30	3.30	0.00	0.00	3.30	3.30	0.00	0.00	3.30	3.30	0.00	58
62	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.50	0.0500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	62
63	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	7.50	0.2500	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	63
66	1	4.63	4.63	0.00	0.00	4.63	4.63	0.00	0.00	15.00	0.2400	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	7.45	7.45	0.00	66
71	1	4.63	4.63	0.00	0.00	4.63	4.63	0.00	0.00	15.00	0.0800	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	7.45	7.45	0.00	71
72	1	4.63	4.63	0.00	0.00	4.63	4.63	0.00	0.00	15.00	0.1600	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	7.45	7.45	0.00	72
75	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	15.00	0.0500	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	75
81	1	14.30	14.30	0.00	0.00	14.30	14.30	0.00	0.00	15.00	0.3400	23.01	23.01	0.00	0.00	23.01	23.01	0.00	0.00	23.01	23.01	0.00	81
83	1	8.43	8.43	0.00	0.00	8.43	8.43	0.00	0.00	15.00	0.0200	13.57	13.57	0.00	0.00	13.57	13.57	0.00	0.00	13.57	13.57	0.00	83
86	1	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	15.00	0.0900	11.99	11.99	0.00	0.00	11.99	11.99	0.00	0.00	11.99	11.99	0.00	86
93	1	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	15.00	0.0500	11.99	11.99	0.00	0.00	11.99	11.99	0.00	0.00	11.99	11.99	0.00	93
98	1	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	15.00	0.36700	11.99	11.99	0.00	0.00	11.99	11.99	0.00	0.00	11.99	11.99	0.00	98
100	1	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	15.00	0.1000	11.99	11.99	0.00	0.00	11.99	11.99	0.00	0.00	11.99	11.99	0.00	100
103	1	4.63	4.63	0.00	0.00	4.63	4.63	0.00	0.00	15.00	0.0200	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	7.45	7.45	0.00	103
104	1	4.63	4.63	0.00	0.00	4.63	4.63	0.00	0.00	15.00	0.7400	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	7.45	7.45	0.00	104
113	1	3.51	3.51	0.00	0.00	3.51	3.51	0.00	0.00	15.00	0.2800	5.65	5.65	0.00	0.00	5.65	5.65	0.00	0.00	5.65	5.65	0.00	113
116	1	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	30.00	0.0100	11.99	11.99	0.00	0.00	11.99	11.99	0.00	0.00	11.99	11.99	0.00	116
117	1	4.63	4.63	0.00	0.00	4.63	4.63	0.00	0.00	30.00	0.0400	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	7.45	7.45	0.00	117
118	1	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	30.00	0.0300	11.99	11.99	0.00	0.00	11.99	11.99	0.00	0.00	11.99	11.99	0.00	118
126	1	4.63	4.63	0.00	0.00	4.63	4.63	0.00	0.00	30.00	0.1000	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	7.45	7.45	0.00	126
127	1	4.63	4.63	0.00	0.00	4.63	4.63	0.00	0.00	30.00	0.1600	7.45	7.45	0.00	0.00	7.45	7.45	0.00	0.00	7.45	7.45	0.00	127

547 1 14.30 14.30 -00 14.30 14.30 -00 14.30 14.30 -0200 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 547
553 1 7.45 7.45 -00 7.45 7.45 -00 15.00 -0000 11.99 11.99 11.99 11.99 -00 11.99 11.99 -00 11.99 11.99 -00 553
555 1 7.45 7.45 -00 7.45 7.45 -00 15.00 -0300 11.99 11.99 11.99 11.99 -00 11.99 11.99 -00 11.99 11.99 -00 555
558 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -0400 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 558
559 1 4.63 4.63 -00 4.63 4.63 -00 15.00 -0300 7.45 7.45 7.45 7.45 -00 7.45 7.45 -00 7.45 7.45 -00 559
564 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -0500 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 564
565 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -2400 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 565
567 1 7.45 7.45 -00 7.45 7.45 -00 15.00 -0100 11.99 11.99 11.99 11.99 -00 11.99 11.99 -00 11.99 11.99 -00 567
568 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -1700 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 568
569 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -0100 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 569
574 1 7.45 7.45 -00 7.45 7.45 -00 15.00 -0500 11.99 11.99 11.99 11.99 -00 11.99 11.99 -00 11.99 11.99 -00 574
582 1 4.63 4.63 -00 4.63 4.63 -00 15.00 -0200 7.45 7.45 7.45 7.45 -00 7.45 7.45 -00 7.45 7.45 -00 582
584 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -2200 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 584
590 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -0400 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 590
595 1 7.45 7.45 -00 7.45 7.45 -00 15.00 -0300 11.99 11.99 11.99 11.99 -00 11.99 11.99 -00 11.99 11.99 -00 595
596 1 4.63 4.63 -00 4.63 4.63 -00 15.00 -0400 7.45 7.45 7.45 7.45 -00 7.45 7.45 -00 7.45 7.45 -00 596
598 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -0200 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 598
603 1 4.63 4.63 -00 4.63 4.63 -00 15.00 -0300 7.45 7.45 7.45 7.45 -00 7.45 7.45 -00 7.45 7.45 -00 603
611 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -1400 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 611
613 1 4.63 4.63 -00 4.63 4.63 -00 15.00 -0600 7.45 7.45 7.45 7.45 -00 7.45 7.45 -00 7.45 7.45 -00 613
614 1 7.45 7.45 -00 7.45 7.45 -00 15.00 -0400 11.99 11.99 11.99 11.99 -00 11.99 11.99 -00 11.99 11.99 -00 614
616 1 7.45 7.45 -00 7.45 7.45 -00 15.00 -1600 11.99 11.99 11.99 11.99 -00 11.99 11.99 -00 11.99 11.99 -00 616
632 1 7.45 7.45 -00 7.45 7.45 -00 15.00 -0500 11.99 11.99 11.99 11.99 -00 11.99 11.99 -00 11.99 11.99 -00 632
634 1 7.45 7.45 -00 7.45 7.45 -00 15.00 2.7100 11.99 11.99 11.99 11.99 -00 11.99 11.99 -00 11.99 11.99 -00 634
636 1 4.63 4.63 -00 4.63 4.63 -00 15.00 -0300 7.45 7.45 7.45 7.45 -00 7.45 7.45 -00 7.45 7.45 -00 636
639 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -0300 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 639
641 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -0500 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 641
652 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -0300 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 652
665 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -0600 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 665
670 1 4.63 4.63 -00 4.63 4.63 -00 15.00 -0200 7.45 7.45 7.45 7.45 -00 7.45 7.45 -00 7.45 7.45 -00 670
673 1 14.30 14.30 -00 14.30 14.30 -00 15.00 3.9100 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 673
674 1 4.63 4.63 -00 4.63 4.63 -00 15.00 -0900 7.45 7.45 7.45 7.45 -00 7.45 7.45 -00 7.45 7.45 -00 674
677 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -0200 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 677
679 1 9.47 9.47 -00 9.47 9.47 -00 15.00 -0300 15.24 15.24 15.24 15.24 -00 15.24 15.24 -00 15.24 15.24 -00 679
681 1 2.05 2.05 -00 2.05 2.05 -00 15.00 1.2600 3.30 3.30 3.30 3.30 -00 3.30 3.30 -00 3.30 3.30 -00 681
682 1 2.05 2.05 -00 2.05 2.05 -00 15.00 -0600 3.30 3.30 3.30 3.30 -00 3.30 3.30 -00 3.30 3.30 -00 682
686 1 2.05 2.05 -00 2.05 2.05 -00 15.00 -0100 3.30 3.30 3.30 3.30 -00 3.30 3.30 -00 3.30 3.30 -00 686
692 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -1000 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 692
694 1 7.45 7.45 -00 7.45 7.45 -00 15.00 -2200 11.99 11.99 11.99 11.99 -00 11.99 11.99 -00 11.99 11.99 -00 694
697 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -0500 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 697
698 1 2.05 2.05 -00 2.05 2.05 -00 15.00 -0400 3.30 3.30 3.30 3.30 -00 3.30 3.30 -00 3.30 3.30 -00 698
699 1 2.05 2.05 -00 2.05 2.05 -00 15.00 -0400 3.30 3.30 3.30 3.30 -00 3.30 3.30 -00 3.30 3.30 -00 699
700 1 .00 .00 -00 .00 .00 -00 15.00 -0800 .00 .00 .00 .00 -00 .00 .00 -00 .00 .00 -00 700
704 1 14.30 14.30 -00 14.30 14.30 -00 15.00 -2300 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 704
709 1 3.51 3.51 -00 3.51 3.51 -00 15.00 -0000 5.65 5.65 5.65 5.65 -00 5.65 5.65 -00 5.65 5.65 -00 709
723 1 .00 .00 -00 .00 .00 -00 15.00 -0900 .00 .00 .00 .00 -00 .00 .00 -00 .00 .00 -00 723
725 1 4.63 4.63 -00 4.63 4.63 -00 30.00 -0700 7.45 7.45 7.45 7.45 -00 7.45 7.45 -00 7.45 7.45 -00 725
731 1 14.30 14.30 -00 14.30 14.30 -00 30.00 -4700 23.01 23.01 23.01 23.01 -00 23.01 23.01 -00 23.01 23.01 -00 731

1399	1	14.30	14.30	-00	14.30	14.30	-00	30.00	-0200	23.01	23.01	-00	23.01	23.01	-00	1399
1402	1	14.30	14.30	-00	14.30	14.30	-00	30.00	-0600	23.01	23.01	-00	23.01	23.01	-00	1402
1403	1	14.30	14.30	-00	14.30	14.30	-00	30.00	-1100	23.01	23.01	-00	23.01	23.01	-00	1403
1404	1	2.05	2.05	-00	2.05	2.05	-00	30.00	-0500	3.30	3.30	-00	3.30	3.30	-00	1404
1406	1	14.30	14.30	-00	14.30	14.30	-00	30.00	-0600	23.01	23.01	-00	23.01	23.01	-00	1406
1407	1	10.94	10.94	-00	10.94	10.94	-00	50.00	-1900	17.60	17.60	-00	17.60	17.60	-00	1407

563	1	1	-00	-00	-00	26.36	30.00	*****	-00	-00	-00	26.36	30.00	*****	-00	-00	-00	42.42	-00	563
564	1	1	-00	-00	-00	26.36	30.00	*****	-00	-00	-00	26.36	30.00	*****	-00	-00	-00	42.42	-00	564
565	1	1	-00	-00	-00	22.83	30.00	*****	-00	-00	-00	22.83	30.00	*****	-00	-00	-00	36.75	-00	565
566	1	1	-00	-00	-00	22.83	30.00	*****	-00	-00	-00	22.83	30.00	*****	-00	-00	-00	36.75	-00	566
567	1	1	-00	-00	-00	22.83	30.00	*****	-00	-00	-00	22.83	30.00	*****	-00	-00	-00	36.75	-00	567
568	1	1	-00	-00	-00	22.83	30.00	*****	-00	-00	-00	22.83	30.00	*****	-00	-00	-00	36.75	-00	568
569	1	1	-00	-00	-00	7.45	30.00	*****	-00	-00	-00	7.45	30.00	*****	-00	-00	-00	11.99	-00	569
570	1	1	-00	-00	-00	27.77	30.00	*****	-00	-00	-00	27.77	30.00	*****	-00	-00	-00	44.69	-00	570
571	1	1	-00	-00	-00	27.77	30.00	*****	-00	-00	-00	27.77	30.00	*****	-00	-00	-00	11.99	-00	571
572	1	1	-00	-00	-00	7.45	65.00	*****	-00	-00	-00	7.45	65.00	*****	-00	-00	-00	11.99	-00	572
573	1	1	-00	-00	-00	7.45	65.00	*****	-00	-00	-00	7.45	65.00	*****	-00	-00	-00	11.99	-00	573
574	1	1	-00	-00	-00	7.45	65.00	*****	-00	-00	-00	7.45	65.00	*****	-00	-00	-00	11.99	-00	574
575	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	575
576	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	576
577	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	577
578	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	578
579	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	579
580	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	580
581	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	581
582	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	582
583	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	583
584	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	584
585	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	585
586	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	586
587	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	587
588	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	588
589	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	589
590	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	590
591	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	591
592	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	592
593	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	593
594	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	594
595	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	595
596	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	596
597	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	597
598	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	598
599	1	1	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	1.00	1.00	*****	-00	-00	-00	44.69	-00	599
600	1	1	34.68	34.68	34.68	34.68	34.68	*****	-00	-00	-00	34.68	34.68	*****	55.81	55.81	55.81	55.81	55.81	600
601	1	1	22.83	22.83	22.83	22.83	22.83	*****	-00	-00	-00	22.83	22.83	*****	36.75	36.75	36.75	36.75	36.75	601
602	1	1	12.81	12.49	12.49	13.50	13.50	*****	-00	-00	-00	12.49	13.50	*****	20.10	20.10	20.10	20.10	20.10	602
603	1	1	7.45	7.45	7.45	7.45	7.45	*****	-00	-00	-00	7.45	7.45	*****	11.99	11.99	11.99	11.99	11.99	603
604	1	1	28.22	25.78	28.50	30.83	30.83	*****	-00	-00	-00	28.50	30.83	*****	45.41	45.41	45.41	45.41	45.41	604
605	1	1	12.49	12.49	12.49	12.49	12.49	*****	-00	-00	-00	12.49	12.49	*****	11.99	11.99	11.99	11.99	11.99	605
606	1	1	15.50	14.69	15.55	16.36	16.36	*****	-00	-00	-00	15.55	16.36	*****	20.10	20.10	20.10	20.10	20.10	606
607	1	1	15.50	14.69	15.55	16.36	16.36	*****	-00	-00	-00	15.55	16.36	*****	24.95	24.95	24.95	24.95	24.95	607
608	1	1	15.50	14.69	15.55	16.36	16.36	*****	-00	-00	-00	15.55	16.36	*****	25.03	25.03	25.03	25.03	25.03	608
609	1	1	7.45	7.45	7.45	7.45	7.45	*****	-00	-00	-00	7.45	7.45	*****	11.99	11.99	11.99	11.99	11.99	609
610	1	1	15.50	14.69	15.55	16.36	16.36	*****	-00	-00	-00	15.55	16.36	*****	23.64	23.64	23.64	23.64	23.64	610

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall document is classified)

1. ORIGINATING ACTIVITY Defence Research Establishment Suffield		2a. DOCUMENT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. DOCUMENT TITLE NATO Reference Mobility Model Evaluation of the Iltis 4X4 Truck			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Memorandum			
5. AUTHOR(S) (Last name, first name, middle initial) Hanna, D.M., Patterson, D.M.			
6. DOCUMENT DATE May 1988		7a. TOTAL NO. OF PAGES	7b. NO. OF REFS 3
8a. PROJECT OR GRANT NO.		9a. ORIGINATOR'S DOCUMENT NUMBER(S) Suffield Memorandum No. 1227	
8b. CONTRACT NO.		9b. OTHER DOCUMENT NO.(S) (Any other numbers that may be assigned this document) ACN 0316X	
10. DISTRIBUTION STATEMENT Unlimited			
11. SUPPLEMENTARY NOTES		12. SPONSORING ACTIVITY Defence Research Establishment Suffield	
13. ABSTRACT <p>The Directorate of Land Requirements (DLR), in an effort to assess the usefulness of the NATO Reference Mobility Model (NRMM) in vehicle procurement activities, initiated a study at the Defence Research Establishment Suffield with the following objectives: 1) to determine the difficulty and time required to provide all necessary NRMM input data for a typical wheeled vehicle; 2) to determine the time required to perform an NRMM evaluation; and 3) to establish a wheeled vehicle baseline. The vehicle chosen for this study was the Iltis 4X4 ¼ ton truck. All required vehicle characteristics were obtained within an acceptable time frame with the exception of the pitch-mass-moment of inertia of the sprung mass, which eventually was measured at an American laboratory. The NRMM simulation of the Iltis 4X4 required approximately one month to complete. The baseline performance is represented by curves of speed versus cumulative percent of area and by a mobility rating speed of 40 kilometers per hour over representative German terrain.</p>			

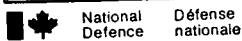
UNCLASSIFIED

ABSTRACTED BY

oak
JUN 9 1988

NO. OF COPIES NOMBRE DE COPIES	COPY NO. COPIE N°	INFORMATION SCIENTIST'S INITIALS INITIALES DE L'AGENT D'INFORMATION SCIENTIFIQUE
1	1	DAR
AQUISITION ROUTE FOURNI PAR	DRES	
DATE	06 JUNE 1988	
DSIS ACCESSION NO. NUMÉRO DSIS	88-0000	

DND 1158 (6-87)



**PLEASE RETURN THIS DOCUMENT
TO THE FOLLOWING ADDRESS:**

DIRECTOR
SCIENTIFIC INFORMATION SERVICES
NATIONAL DEFENCE
HEADQUARTERS
OTTAWA, ONT. - CANADA K1A 0K2

**PRIÈRE DE RETOURNER CE DOCUMENT
À L'ADRESSE SUIVANTE:**

DIRECTEUR
SERVICES D'INFORMATION SCIENTIFIQUES
QUARTIER GÉNÉRAL
DE LA DÉFENSE NATIONALE
OTTAWA, ONT. - CANADA K1A 0K2

JUN 10 1988

UNCLASSIFIED